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Engineering Management

Having taken out a degree or diploma, many young electronics engineers appear to imagine that they will be able to devote the rest of their career to research and development. It doesn't always work out that way.

In due course, as a direct result of their attainments, they may be put in charge of projects and people and inherit the paper work and personality problems that projects and people involve. As the years go by, and as seniority builds up, they find their time absorbed more and more by administrative responsibilities.

The result, in many cases, is a personal crisis. With so much time diverted to documents and interviews, the engineer senses that he is getting away from the bench; that other s junior to him are doing the jobs he would like to do himself—and that he is becoming reliant on them. He begins to wonder whether or not he is prostituting his training; whether he should repudiate the administrative and concentrate purely on the technical.

But the alternative also deters him. Someone junior to him, or less academically skilled, may be moved into the administrative post—to make the decisions and gain the promotions.

The problem, in some degree, stems from a lack of emphasis, in the training of young engineers, on the "administrative" and "human" side of their profession — on engineering management, in short.

To be sure, the bench, the instruments, the books are vital, and it is logical that engineers should be given the greatest possible opportunity to develop and utilise their technical proficiency, without being diverted to trivialities.

But the smooth running of a laboratory team is not triviality; the relevance of engineering costs and problems to a commercial venture is not a triviality; neither are matters to do with other technical staff, production, quality control, materials supply, commercial design, public relations.

In a technological community, such matters are no less vital than pure research. They demand special talents and their proper handling can be no less the source of personal satisfaction. The engineer who responds to the challenge of management and administration should have no doubts about the dignity of his choice.

N. Williams

eptember, 1966

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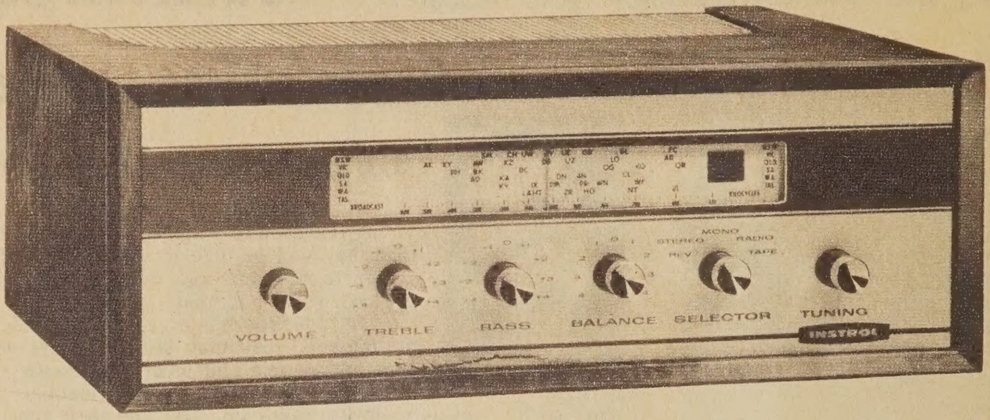
COVER PICTURE: A gold wire bonding machine at Anodeon Semiconductor Division, Huntingdale, Vic. The wire (0.001" dia.) is thermo-compression bonded to the emitter and base pads of a silicon transistor junction. The machine is equipped with a micromanipulator which allows the operator to position the wire with an accuracy much better than its own diameter. The machine performs the operation on single transistors or integrated circuits.

New INSTROL Amplifier-tune



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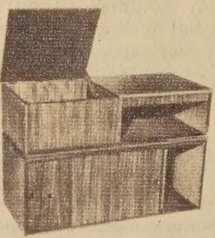
INSTROL ...fine audio furnitu



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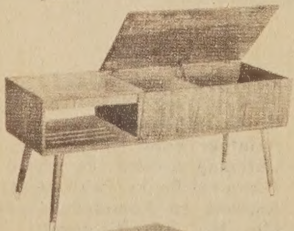
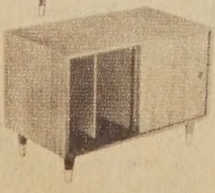
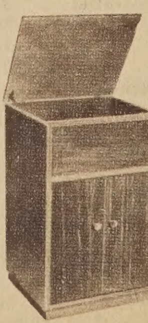
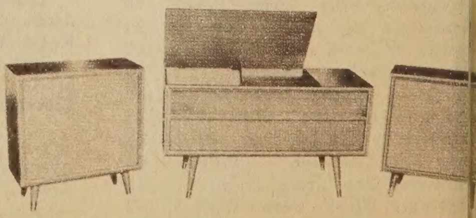




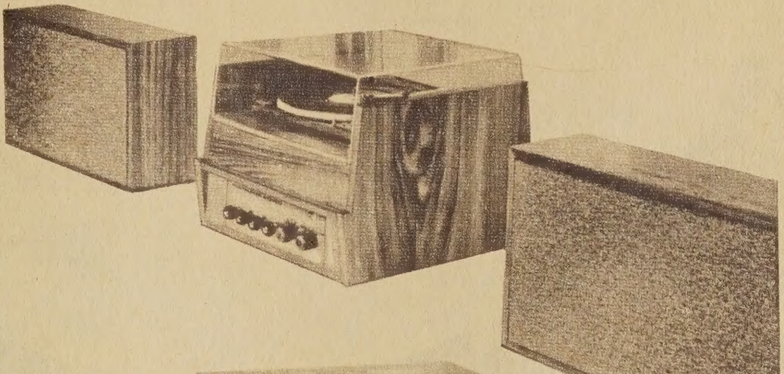


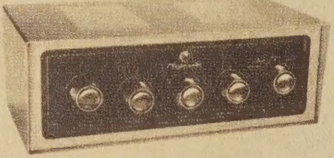


Produced precisely to the original designs by "Electronics Australia" (previously "Radio Television & Hobbies") the Instrol — Playmaster range includes units to suit every audio requirement. Tuners Amplifiers, Pre-Amps, Speaker Systems, etc., all available either as completely built and tested units, or in Kit form to build yourself. Our HI-FI Catalogue is available free upon request.

INSTROL—*PLAYMASTER*

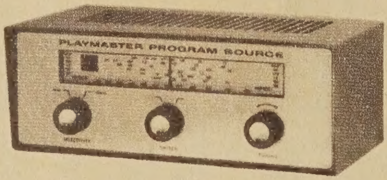
Top right. The Instrol-Playmaster transistorised Stereo Amplifier No. 113 ("Electronics Australia," December, 1965 and March, 1966). Fitted in specially designed cabinet which also accommodates a record player. A pair of Instrol-Playmaster Bookshelf Speaker systems, make up a compact, reasonably priced outfit.





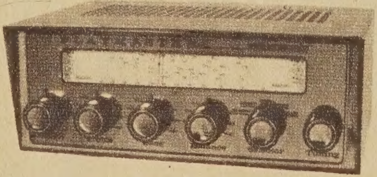
Instrol-Playmaster No. 4 Stereo Amplifier. ("Radio Television and Hobbies" May, 1962)

Kit of Parts	**$73.00**
Built and Tested	**$93.80**



Instrol-Playmaster No. 111 Tuner ("Electronics Australia" October, 1965)

Kit of Parts	**$39.00**
Built and Tested	**$53.00**



Instrol-Playmaster No. 106 Stereo Amp/Tuner. ("Radio, Television & Hobbies," December, 1963).

Kit of Parts	**$96.50**
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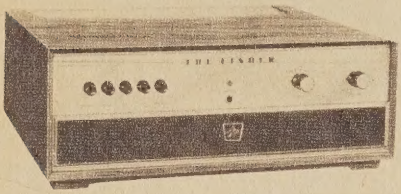
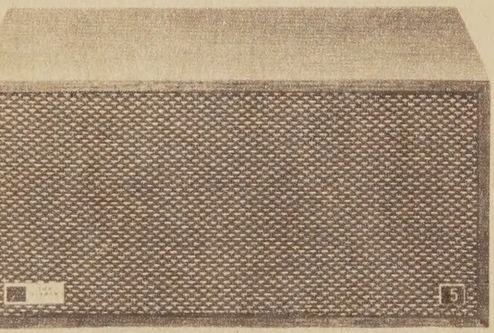


The Fisher X-101-C
60-Watt Stereo Control-Amplifier

with heavy-duty output circuitry, exclusive hinged cover over the less frequently used controls, centre-channel output for optional third speaker, front-panel headphone jack, complete phono and tape facilities: **$296.**



The Fisher XP-5
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with 8″ low-resonance woofer, 2½″ wide dispersion tweeter, 2,000 cps crossover, clean response down to 38 cps: **$98.**

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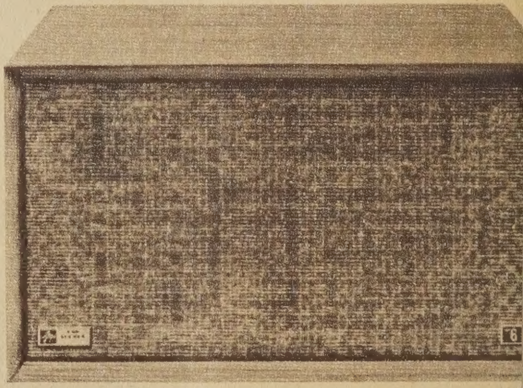
facilities: **$240.**



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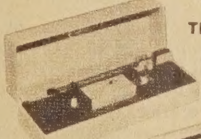

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CK-15-LS Lab Standard Phono Conversion Kit. U-15-LS cartridge (biradial diamond) for standard heads, and PS-15 power source. For magnetic or auxiliary inputs. **$94**

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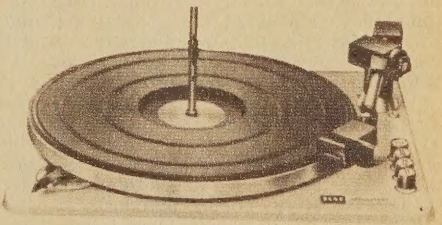
The new Elac 240 mono/stereo cartridge in the Miracord 40 has an 0.7 mil diamond stylus. It is distinguished by clean channel separation, low distortion and smooth, flat response. Its performance is comparable to many highly reputed, stereo-only cartridges available today.

The new Miracord 40 is priced at $109 complete with Elac 240 cartridge. See and hear it at your hi-fi dealer.

**May also be purchased without cartridge*

new ELAC MIRACORD 40



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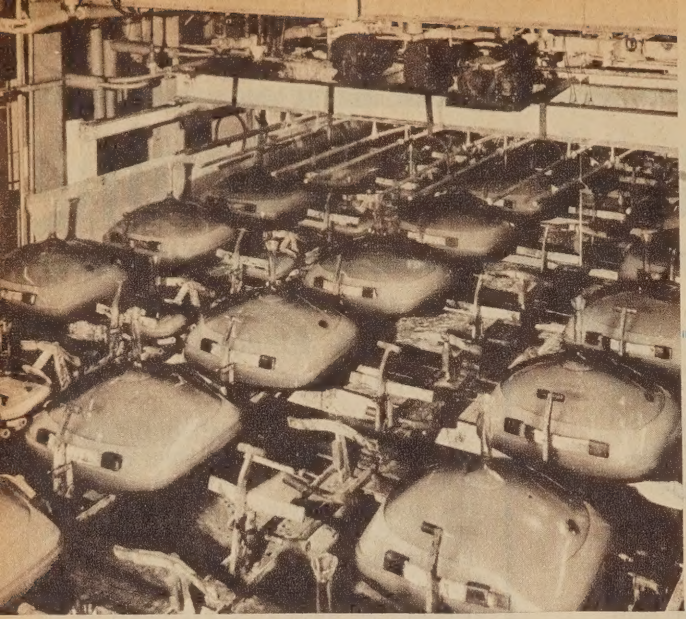


Picture tube producti

WATER-

Tubes on the slowly-moving settling belts at the Anodeon cathode-ray tube factory in Melbourne. The treated "cushion" water is first dispensed into the envelope, followed by the precisely controlled and distributed "phosphor" material. The phosphor gradually settles on the tube face, being left there as the tube is slowly and automatically tilted to decanter the cushion water at a controlled rate.

By Alan Twining (Anodeon Picture Tube Factory)

No matter how crystal-clear it may look as it flows from the kitchen tap, the water which we use for everyday drinking and cooking is not nearly pure enough for many processes encountered in the electronics industry.

A typical case is the production of cathode-ray tubes, where water used in critical stages has to be extensively treated to remove all traces of impurities which might "poison" the delicate screen "phosphor." A vital factor, therefore, in the production of high-quality picture tubes, is adequate and effective equipment to filter and de-mineralise the water used.

At the outset, it is well to point out that the screen "phosphor" which is used to display the video information is, in fact, not related to the chemical phosphorus. The correct chemical term for the actual screen material is zinc cadmium sulphide. This substance, which is used as a powder mixture, is extremely sensitive to "poisoning" by both organic and mineral substances.

The effect of poisoning is generally in a change of colour in the affected area. Iron contaminates modify the phosphor toward the blue direction when the material is subjected to electron bombardment, while copper produces a colour shift toward green. Organic contaminants generally produce a more greyish colour shift, along with the possibility of poor screen adherence to the inside of the glass face.

By and large, each different chemical will produce its own characteristic colour shift and, when screens are found to be contaminated, an exacting examination of the poisoned area will often reveal the source of the trouble and enable remedial action to be taken. If it were otherwise, an extremely difficult chemical analysis project might be involved, searching for contaminants which, for the most part, are present only in trace element proportions.

To minimise possible difficulties with screen contamination, it is essential to completely remove organic substances and minerals from bulk water before it is used as a settling medium for the zinc cadmium sulphide powder.

Raw water is taken from the Melbourne Board of Works mains and chemically treated in three quite distinct stages, each aimed at eliminating specific types of contamination.

In the first stage, raw water is directed toward a large, plastic-lined tank. Just before entry into the tank, three chemicals—ferrous sulphate, sodium hydroxide and sodium hypochloride — are dosed into the stream of water by a mechanical injection method.

The admixture of these chemicals produces a heavy floc, giving rise to the term "floc tank" for this first container. The floc is a gelatinous substance, which is the product of a reaction between sodium hydroxide and ferrous sulphate, the latter having been first oxidised by the sodium hypochloride.

Chemical control must be accurately maintained so that the pH (hydrogen ion value) of the water in the floc tank will be slightly acidic and in the vicinity of 6, measured on a Cambridge pH meter.

At the same time, there must be a relatively strong solution of free chlorine, which has the general effect of destroying organic matter and the bacteria which is so prevalent in water systems. In fact, slime in water is an accumulation of the dead bodies of bacteria and it is not difficult to appreciate that even minute accumulations of slime in a cathode ray tube during screening can make good contact of the powder to the inside of the face almost impossible.

The floc tank is constructed with a large diagonal baffle and a narrow slot at the lower end. The raw water is forced down through the floc bed, which occupies the lower half of the tank and allowed to rise to the outlet pipe which leads into a clear well.

The floc bed must be sufficiently heavy to inhibit the rise of floc particles in the current of water after it passes under the baffle, so that particles do not reach the outlet pipe and carry over into the clear well.

The floc in this tank has the capacity to absorb most of the heavier minerals, particularly the iron types, together with the coarser metallic substances which are so common in normal supply wat
The bodies of destroyed organisms
also absorbed by the floc.

Trace elements of minerals are
to be removed in this primary tre
ment, however, and we have fou
traces of some extremely rare miner
in the Melbourne water supply, inclu
ing even radium!

The outlet from the clear well
joining the floc tank flows into a la
cylindrical sand filter. This filter cha
ber contains varying grades of sand a
stone, with the coarsest particles at
bottom and the finest particles at
top. The purpose of this chamber is
filter out those light particles of mat
which may remain in colloidal susp
sion, after passing through the floc ta

The outlet of the sand filter passes
the inlet of another cylinder which
filled with an activated carbon, the
ject of this treatment being to rem
the free chlorine from the partia
treated water. The activated carbon
the capacity to exchange free chlor
which, as a point of interest, can
dosed to the extent of 30 parts
million, and convert this to hydrochl
acid.

If the pH of the water entering
carbon filter is around about 6, it
be much closer to a pH of 5 when le
ing the carbon filter. This marks
end of the first stage in the treatme

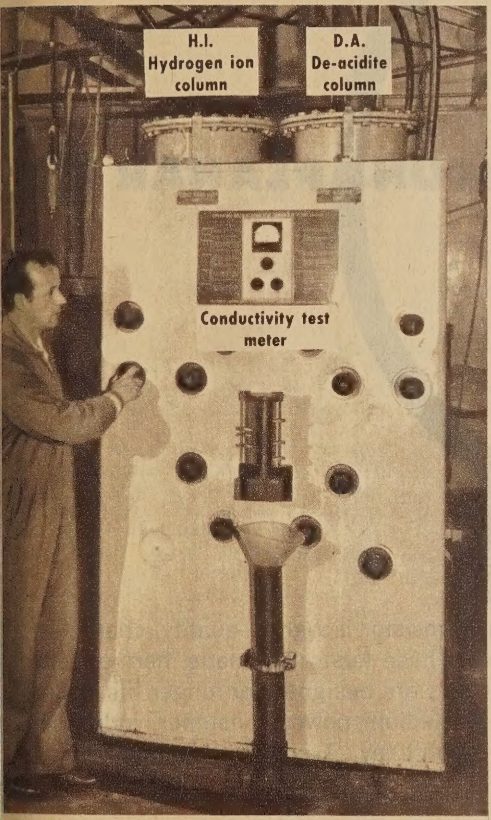
The second stage of treatment is
signed to remove the mineral tr
elements. Water from the carbon fil
enters a plastic lined cylinder, this
being about 8ft tall and 2ft in diame
and filled with tiny grains of a spe
type of wood resin.

This resin has the capacity to abs
hydrochloric acid and, when the
umn is being commissioned for use,
resin is soaked in a strong solution
hydrochloric; surplus acid is "rins
after the particles of resin have abso
ed their capacity of the acidic soluti

The reaction which takes place in
column when the water being trea
passes through it, is the simple Ani
Cation exchange in which the trace
ment metals are exchanged during
process for hydrogen-ions.

depends upon

NOT JUST CLEAN BUT PURE!



Left. The hydrogen-ion column and the deacidate columns. Both are filled with specially selected resins, predosed so that they will absorb trace elements (stage 2) and acid plus CO_2 *(stage 3).*

The gas CO_2 is produced during this action and, as a result, water leaving is column has a high mineral acidity unt, along with the CO_2 product of e reaction.

From here the water passes into the ird stage of treatment which is another lumn similar in dimensions to the last.

This particular chamber is filled with nother selected wood resin which has e capacity to absorb quite large quanties of sodium carbonate and, when ing commissioned for use, a very rong solution of this substance is dosed to the resin-filled chamber and after tal absorbance the surplus is rinsed vay.

Now, when water from the H1 column enters this last chamber, called the -acidite column, the water is neutrald of its acidic content while passing rough the fine grains of predosed resin hich, at the same time, has the capaty to absorb CO_2.

In the normal course of events, this ould be the final treatment of the ter which, by now, is free of both ineral and organic contaminants.

A simple test has been devised to eck the degree of purity of the treat- water and this consists of two elecdes closely spaced in the outlet pipe d having a potential applied across em in series with a microammeter.

Water which exhibits a high degree of purity has a considerably higher resistance than water which contains either metallic or organic contaminants and, therefore, a reading of the current which passes between the electrodes is indicative of the degree of purity achieved in the treatment of the water.

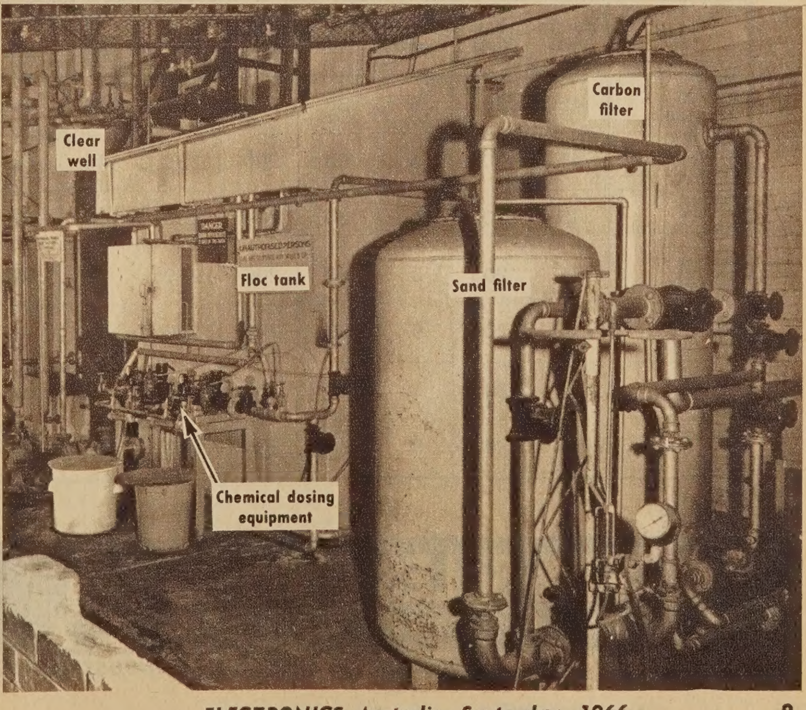
While the calibration of the meter is really empirical it has become an industry standard gained from experience, that 0.6 microamp is the maximum current which can be tolerated and still provide a safe margin for use in the screening procedure. A laboratory technician must take regular checks to see that the conductivity is not greater than this allowable figure.

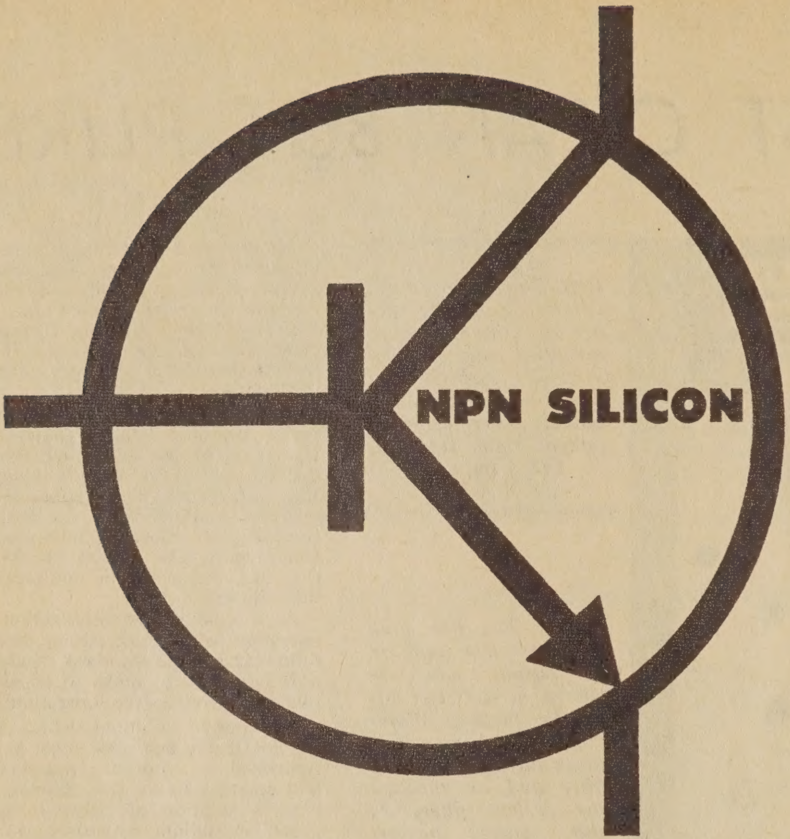
As a quality control function in the operation of demineralising plants the following are the standard checks which it is necessary to make to ensure effective and trouble-free operation:

The dosing solutions which produce the floc in the floc tank, must be strictly controlled to produce a reaction which will create a heavy floc, leaving no surplus in solution of either ferrous sulphate or sodium hydroxide. It is fortunate that the best reaction leaves a slightly acidic solution.

Samples of water must be taken at regular intervals to establish that free chlorine in the solution does not exceed the absolute maximum of 30 parts per million dosed or be less than 18 parts per million on entry into the carbon filter. The avid chemistry student will realise that the 12 parts per million dif-

Below: The floc tank and the "clear well" on its output side are shown at the rear left of the picture. Water from this unit then flows through the sand filter and on through the carbon filter. At this stage heavier particles and gross impurities have been filtered out but trace elements remain, in proportions which may vary from time to time, with variations in bulk water catchment and reticulation.





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DIVISION OF ELECTRONICS INDUSTRIES LIMITED erence is the loss mainly in absorption n the floc, together with the normal eduction resulting from its attack on acteria. The test used to determine the uantity of free chlorine is the normal ilver nitrate test, as taught in all econdary schools.

The pH of the water in the clear-well nust be checked and related to the pH f the water ex carbon filter. It should lways be proportionately lower, inlicating that the activated carbon is till efficient in operation and effectively xchanging sodium hypochloride to ydrochloride acid.

A further silver nitrate test is carried ut for minute traces of free chlorine x carbon filter, the slightest indication f which would indicate that the carbon ed is in need of thorough cleansing, arried out by vigorous back washing.

The next and possibly most important st is at the exit of the HI column here CO_2 and free mineral acidity sts are taken. Any loss in efficiency f the reaction in this column will be ndicated by the decrease in FMA and O_2.

The final test is a straight-out pH heck ex the DA column; the limits ormally expected would be a pH of etween 7.9 and 8.1 which is quite a eutral figure in the terms of screening equirements.

This last test would serve only to conrm an increase in conductivity shown n the conductivity meter and, when is does happen, the change in pH as ell indicates that both the HI and DA olumns need to be regenerated, with eir initial dosing solutions of hydroloric acid and sodium carbonate.

Some plant engineers are not satised with the treatment to date and feel at further treatment is necessary to ive an additional margin of safety in hich to work. They therefore introduce further column called a "mixed bed," which both types of resin used in the I and DA columns are mixed together fter commissioning.

The increase in efficiency is such that onductivity ex the mixed bed column is the order of 1/10th of that read on e first conductivity meter in the outt of the separate column plant.

The water thus treated is then passed to large stainless steel storage tanks. ertain tanks are dosed with barium itrate or barium acetate ready to be sed as "cushion water," that is, the rge bulk of water which is dispensed to the tubes on the screening machine nd into which the phosphor powder d potassium silicate are also dispensed.

Screening procedures may vary mechically from plant to plant but they do t differ to any extent in the chemical nse. While there is a choice of barium trate or barium acetate as a bufferg agent in the cushion water, potasm silicate is invariably the substance hich is used literally to "stick" the osphor to the glass.

The things which are really critical the screening operation are the actual roportions of potassium silicate and rium nitrate-acetate related to the lume of cushion water. The substance hich is normally the subject of adjustent is the quantity of potassium silite which, if it is increased, will give poor wet screen adherence but a very rong dry screen adherence. Naturally ough, it is the aim of the chemist keep the potassium silicate concention as high as is practical, in order to achieve the best possible dry screen adherence. However, if this step is taken to excess, the screen will tend to slide down the face when the cushion water is decanted off after the settling period.

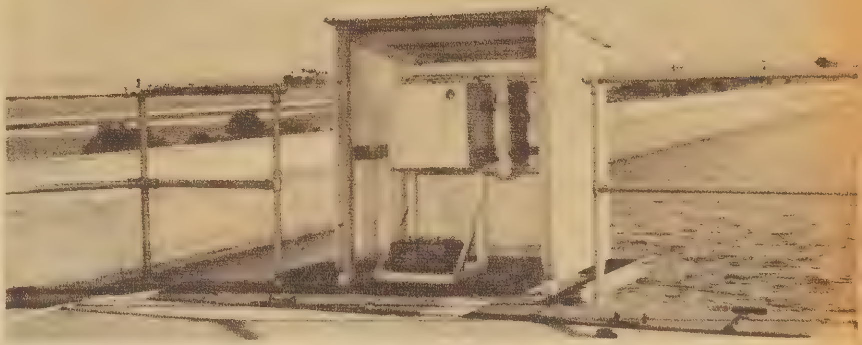
As already mentioned, the cushion water is first admitted to the tube after which the phosphor and potassium silicate are dispensed into this mass.

The shape of the dispensing nozzle is extremely critical, as this will determine primarily where the phosphor will be distributed into the solution; obviously enough, the aim is to produce a uniformly distributed coating.

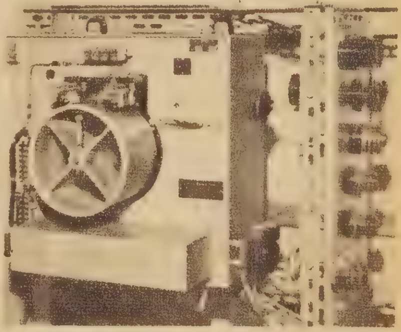
All sorts of methods are used to create the desired eddy currents in the cushion water in order to carry the phosphor evenly to the edges of the tube face; the flatter the tube shape, as for 110 deg. and 114 deg. types, the more difficult this is to achieve.

Maintenance on the whole of the chemical side of the plant is probably the secret to efficient screening in production. From time to time the whole plant must be treated with a strong solution of formalin. The formaldehyde solution is allowed to stay in the plant for several hours before being flushed out in order to inhibit air-borne bacteria from building up colonies within the plant itself and creating slime with its deleterious effects. That the inside of the glass envelopes must also be scrupulously clean is quite obvious and rigorous washing of glass bulbs is carried out before being placed on the screening machine and admission of the cushion water.

MONITORING RESERVOIR LEVELS



The experimental monitor installation at one of Melbourne's reservoirs and, below, a close-up picture of the pulley system (right) which controls the position of the heads along the drum. When the drum rotates on demand, the heads read off the appropriate pre-recorded message.



An automatic metering device linked with the telephone system has taken over the task of monitoring water levels in one of the reservoirs utilised by the Melbourne and Metropolitan Board of Works. The robot-like equipment, called a Sareg Teleindicator, was installed on a test basis several months ago at one of the board's feeder reservoirs and is now in permanent operation.

Prior to installation of the device, the reservoir, like its counterparts in other sections of the Melbourne water supply network, required long periods of manual supervision. In summer, these physical checks totalled as much as 12 hours a day. With the aid of the Sareg Teleindicator, water levels are now checked simply by using a telephone.

When rung, the equipment actuates a magnetic drum containing pre-recorded depth readings. A typical response is: "This is a recorded message from the Board of Works Reservoir. The recorded depth is 14 feet 10 inches."

The teleindicator is mounted on the edge of the reservoir, and is connected by a system of pulleys and stainless steel cable to a floating unit in the water. The upwards or downwards movement of the float operates a cam mechanism attached to the drum containing the pre-recorded messages.

At the moment a telephone call is received, the cams position a magnetic reading head against the drum and the appropriate message is transmitted to the caller. If required, each message can be repeated up to nine times.

Since its installation last September, the automatic device has averaged several hundred calls a month without breakdown. Manpower and other savings made possible by the installation will repay the cost of the equipment in a very short time.

The Sareg equipment was supplied and installed by the Rola Division of the Plessey Components Group. Its successful use in Melbourne is expected to lead to wider application in reservoir control work. It is also considered to have great potential for gas storage, flood control and pumping station operations.

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	41-12	1200	7	4.50	2.25
***Ferrotape 43** • 1 mil Acetate Base • Long Play Professional Quality.* *Type 43 1 mil Acetate tape is available for maximum economy with an extended play of 50%. As companion to the standard economy Ferrotape, it offers the same excellent reproduction and performance.*	Long Play 1 mil Acetate				
	43-9	900	5	4.00	2.00
	43-18	1800	7	6.50	3.25
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	52-18	1800	7	7.50	3.75
***Ferrotape 53** • ½ mil Polyester Base •Extra Long Play Type 53 is for extended play applications where care is exercised in handling. It should be used only on equipment in good adjustment and by an experienced recordist.*	Extra Long Play ½ mil Polyester				
	53-12	1200	5	4.60	2.30
	53-24	2400	7	8.50	4.25
***Ferrotape 56** • ½ mil Tensilized Polyester Base • Extra long play • Extra Strength.* *Type 56 ½ mil Tensilized Polyester makes it extremely strong and stretch-resistant, retaining the extended play features.*	Extra Long Play ½ mil Tensilized Polyester				
	56-12	1200	5	6.50	3.25
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	57-18	1800	5	9.00	4.50
	57-24	2400	5¾	11.70	5.85
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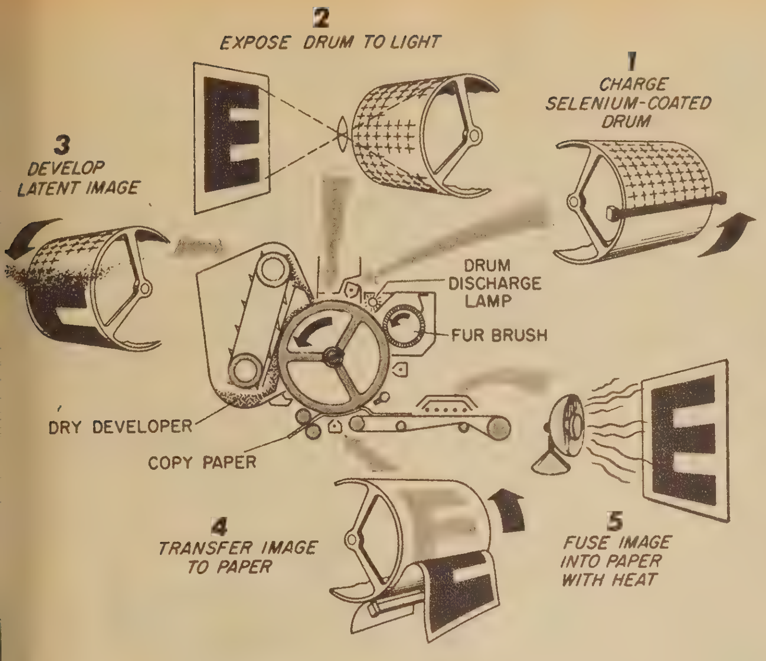

To refresh readers' minds, or to assist those who did not see the previous article, we reproduced this diagram from our March 1966 issue. It portrays the basic steps in xerography.

PRINTED CIRCUITS BY XEROGRAPHY

By R. J. Goodwin*

A major requirement in the production of printed circuit boards is a quick and convenient method of producing "one off" or small quantities for pre-production testing and evaluation. This is normally done using photo-resist techniques, but a more recent innovation employs the xerographic principle similar to that used for document copying.

The names Xerox and xerography ve for some considerable time been onymous with the production of inary copies, in the everyday office, common bond paper. This has come ut through the development of chines like the Rank Xerox 914 pier, the desk-top 813 model and ly the new Rank Xerox Copier- plicator 2400.

rior to the introduction of these omatic machines, a unit known as ndard Xerox equipment was released. s article describes how this equip- nt can be used for the production of mical resist images on metal surfaces.

efore going on to describe the actual cedure involved in the production of st images, we feel the point should made that it is assumed that all the ders will be reasonably conversant the principles of the process as lined in the article which was pub- ed in the March, 1966, issue of ECTRONICS Australia."

he items of equipment required to ieve acceptable results by xerography a variable ratio camera and Rank ox processing unit complete with e tray and vapour fuser. These units form all the functions in the produc- of a high quality resist image.

the production of resist images by graphy, one requirement is a little rent from the normal photo resist hods. This is that the artwork must drawn as seen from the component of the board or, in other words, a ror reverse when looking at the al copper side of the board. This is because of the special transfer technique which is involved.

When the artwork is prepared, it is placed on the copy board of a variable ratio camera. Wherever artwork is prepared on translucent material, it is preferably lit from behind, since this will produce greater definition and lessen any chance of shadow effects.

A photoconductive selenium plate is charged in the processing unit and placed in the back of the camera. It is then exposed to the artwork, producing a latent electrical image on the selenium plate. The plate is then developed in a tone tray. This type of tray has an electrode placed within it, producing a very intense field close to the exposed selenium plate. This ensures complete coverage of any large solid areas.

After the plate is developed and removed from the tone tray the image will appear to be very dense and furry. This furriness can be disregarded since this will not appear on the completed board. At this stage, with the normal Xerox process, the image would be transferred to paper and subsequently fused, thus producing a completed copy. The procedure involved for transferring this image to the circuit board laminate is rather different, mainly because it would be extremely injurious to the selenium coating of the plate to allow the copper laminate to come in contact with it.

To transfer the image a piece of suitably sized .003in thickness cellulose acetate is laid over the developed image on the plate. It is then inserted into the Rank Xerox processor and a positive transfer charge applied, causing the powder image to be attracted to the surface of the acetate. The plate is withdrawn from the processing unit and the acetate peeled off. The image of the artwork has now been transferred almost completely to the acetate, but the furriness which was present after development has stayed on the plate.

The selenium plate itself is cleaned ready for production of the next image, and stowed in the dispenser unit. The sheet of acetate with the unfused powder image is examined and any corrections or deletions made. To transfer the image to the copper of the laminate, it is necessary to have an old Xerox plate, the "transfer plate," reversed in its holder so that the aluminium side is showing uppermost. This is usually fitted with guides to locate the board and the acetate, and an earthing clip to come into contact with the copper surface of the laminate.

The laminate itself is placed face upwards (copper side uppermost on the "transfer plate"), and carefully located under the earthing clip. The acetate sheet with its unfused image is laid face down on top of the copper, the whole unit inserted into the processing unit, and a negative charge applied. The negative charge will tend to repel the image from the acetate surface and force it on to the copper. After withdrawal from the processing unit, the acetate is peeled off, leaving the image transferred to the copper surface.

The final stage is to take the copper laminate with its image and place it in the vapour fusing unit. It is then subjected to the vapour of trichlorethylene which fixes the image firmly on the copper. The laminate is now ready for etching subject, of course, to any retouching which may be found necessary. Normally, this is most unlikely except

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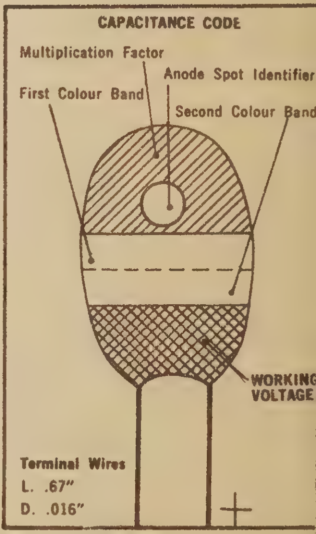
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when extremely large solid areas are involved. This completes the procedure of producing a chemical resist image on a board ready for etching.

The time involved is something in the order of five minutes, and is considerably faster than normal photo resist methods. It should be emphasised that the xerographic method is not intended for mass production techniques. Here silk screening still holds its own. It does, however, offer vast time and cost savings against the conventional photo resist method, especially since the entire operation is one which can be carried out in full daylight and does not involve the use of light sensitive materials or liquid chemicals.

A common requirement in the production of printed boards is an assembly drawing on the reverse side of the board, showing the location and value of components. An interesting sidelight to the Xerox method of producing the board itself is that this same system may be used for the assembly diagram.

The procedure is simply that the original circuit board artwork is mounted in the camera so that it is right reading to the lens, and then overlaid by a white dot screen of approximately 25 dots per inch. An exposure is made of this screened artwork and is transferred onto the reverse side of a piece of translucent material. Either tracing paper or tracing cloth may be used. When viewed from the correct side the layout appears to be reverse reading: in other words, exactly as it would appear from the component side.

The draftsman completes the assembly drawing on the face by drawing in the components. He locates these visually from the terminal pad locations on the reverse side of the drawing. This eliminates measuring and reduces the chance of error. He then completes the title block, labels each component and adds overall dimensions. Subsequent prints from this tracing show the detail of each mounted component superimposed on the screened ghost image of the circuit.

A further advantage is in the production of drill templates. When several boards of the same style are being produced it may be more economical to make a simple drilling template than to drill the boards individually. The templates are normally made from one-eighth to one-quarter inch aluminium plates with hole drilled in the same pattern as the circuit board terminal holes. Locating pins are added so that the template may be positioned accurately on top of each board and the boards drilled through the template holes.

Xerography is used to transfer the image of the artwork to the plate. The circuit artwork is placed in the camera so that it is reverse reading, that is, as for the production of the board itself. Following the same procedure as that used in the production of an actual board, the image is transferred from the acetate to the aluminium plate in the processing unit, and is fused in the vapour fuser. A centre punch is then used to mark each hole location, and holes are drilled through the template.

Locations are accurate enough within plus or minus one sixty-fourth of an inch to mount and attach the components in the assembly operation. If a template were not used, more care would be necessary in the drilling operation. If a larger quantity of boards is to be run, the template can be made more permanent and less apt to wear by using steel and hardening its surface in a heat treating operation.

Having read this far the reader may be wondering about registration in the case of double-sided circuit boards, and whether this can be achieved to within any close tolerance. The answer to this would be yes, using a method which is common to the cartoon animation industry, where Xerography also plays its part.

Digressing from the subject slightly, it can be said that the majority of the major cartoon animation studios such as Hanna-Barbera, Walt Disney, etc., are all using this same standard Xerox equipment for the production of the cellulose acetate transparencies necessary in their work. Here, naturally, very close registration is essential especially as, when the cartoon is shown in the average cinema, it will be greatly enlarged.

A Rank Xerox variable ratio camera, such as used for printed circuit board production. A photoconductive selenium plate is used in place of the normal chemical emulsion plate.

Achieving this sort of accuracy with printed circuit boards is not difficult and in fact an identical procedure is used to that of the animated cartoon studios. Artwork is prepared using paper which is punched with two holes along one edge. This paper is used on a drawing board which has two locating pins, ensuring the registration of any one piece of artwork with any other.

In addition, the copy board of the camera is fitted with two similar pins, as are the borders of the selenium plates and the circuit transfer plate.

The sequence of events from this should be fairly obvious. The artwork is placed on the camera copy board over the locating pins. An image is obtained on the selenium plate and transferred to acetate. The acetate has two holes which locate over the registration pins in the border of the plate itself. Normally, double-sided boards will have two locating holes in them. The board is placed over the locating pins of the transfer plate. The acetate with its unfused image is then placed over the locating pins face down and transfer effected in the normal way. The board is removed, fused and then ready for etching.

Using this method of registration extremely fine tolerances can be maintained and no difficulty should be experienced in locating the terminal pad on one side with the terminal pad on the other side of the circuit board.

New applications are coming to light every week for this remarkably versatile equipment. One which came into being quite recently concerned the production of nameplates, dials, etc., using the anodising process. The use to which xerography is put within this particular application is very much the same as for printed circuit boards. Where a two-colour anodised article is required it is first anodised, we will say, in a natural colour. After this a resist image is applied, using the standard xerographic technique as for printed wiring boards.

Subsequently, the anodised article, together with its now resistive image, is placed in a dye bath and this dye creates the second colour in the natural anodising. After completion of sealing, washing, etc., the xerographic image is removed, leaving the image anodised in one colour and the rest of the article in a completely natural state.

Where an article is required in two different colours, say, gold for one area and black for the other, a slightly different procedure must be adopted in the anodising process. But, once again, the xerographic chemical resist image can withstand all the materials used.

In conclusion, it should be pointed out that normal Rank Xerox consumable materials are not particularly suited to the production of chemical resist images. A special toner and developer known as Type 22 should be used for this application to provide greater covering power and denser image which will resist the etching chemicals.

Great care should also be exercised so far as environmental conditions are concerned, since these particular materials have a great affinity for moisture. Wherever possible work should be carried out in an air-conditioned room with a temperature of approximately 65 degrees and a relative humidity of 50 per cent. If this is not possible, a dehumidifying cabinet may be used and the materials retained in the cabinet until required for use.

The latter method can be extremely successful, and the author has in fact undertaken several projects involving the production of circuit boards including the Playmaster 112 Stereo Amplifier Control Unit for his own use. ▪

The one mile long east-west arr of the Mills Cross Radio Tele scope recently erected at th Molonglo Radio Observator near Canberra.

Growth of Radio Astronom

One of the exciting scientific breakthroughs since World War II has been the development of the radio telescope. This story, by Anthony Tucker, Science Correspondent of "The Guardian" (London) traces the history of these devices from the first crude amateur efforts to the modern complex aerials which dot our landscape.

In 1894 Sir Oliver Lodge, in the footsteps of Edison, set up a loop of wire in a shed outside the physics building of Liverpool University. It was connected to an electro-magnet in whose field a tiny suspended mirror was reflecting a light-spot on to the wall. This was the only light but, as the sun came up over the blacked-out shed, Lodge was hoping to see a displacement of the light-spot as a result of long wave radiations from the sun.

There were irregular displacements of the spot all right, but it soon became clear that they had something to do with Liverpool, not with the sun. "There were," wrote Sir Oliver later in that year, "far too many local sources of disturbance in Liverpool to make the experiment feasible." Modern radio-astronomers would sympathise about the presence of radio "noise."

But it was not radio noise that defeated the first experiment of radio-astronomy in Europe, it was lack of knowledge. The idea was right, but the equipment was hopelessly wrong.

We now know that, even had Liverpool been radio-quiet, the experir could not have succeeded. The feeble radio waves which reach us f space call for extremely sensitive ceivers, and radio waves of the w lengths that could have been pickec by Lodge's loop never reach us f space at all. Apart from the nar band of visible frequencies, and anc band of radiations with wavelength a few centimetres up to a few me the atmosphere with its ionised la effectively blankets the earth from tro-magnetic radiations. We have two chinks through which to look space, and Sir Oliver was loo through neither of them.

It fell, not to professional physi but to American radio amateurs to cover the radio chink. This was al

40 years later and already World Wa was looming. By then Jansky, wi home-made dish aerial, had listene the noise of the stars, and anc American amateur had detected e sions from the sun.

Yet, in spite of the war and Americans' early work, it was during after the war in Britain that radio a nomy grew into a true science. It spr not from the generalised short- radio work of the amateurs, but the metre and centimetre wavele work of radar in wartime. Almost e leading radio-astronomer in the Wes gan, not as an astronomer, but physicist working under military sec in Britain.

One of the most prominent an them was J. S. Hey who, studying efficiency of army radar equipment of the effects of enemy jamming, covered that a massive radar blac which disturbed the High Comn did not originate on the other sid the lines but at the centre of the system. This was the first indica that violent radio emissions were ciated with sunspots and it led dir to the establishment of radio obs tories at Cambridge and Sydney, tralia, after the war.

But, before these were established, used army radar equipment to that every meteor leaves an ionised behind it and went on to demons that radar echoes could be used t veal the nature of layering in the u atmosphere and to "see" meteor str with greater intensity than had possible before.

More than this, using the most tive directional aerial he could con from existing equipment, Hey carrie the first major planned observationa periment in radio astronomy. He se and succeeded in plotting a map of emission from the northern sky. resolution was coarse but it clearly s ed the prominence of the Milky It also revealed a single spot in

The complete Mills Cross. It was built under the direction of its Australian inventor, Professor B. Y. Mills, and is a major facility of the Cornell-Sydney University Astronomy Centre.

onstellation of Cygnus which seemed to a separate, powerful but fluctuating ansmitter. He interpreted this as a discete source and in doing so opened the oor on radio astronomy's real possibi- ies.

Hey's work, on which so much rests, as published in the late 1940s, and after at progress became increasingly rapid. was realised that to see at all clearly ith radio, receivers of an unprecedent- accuracy and sensitivity were needed d that, for particular areas of study, articular equipment would have to be esigned. In the 1950s the giant tele- opes began to go up, and the first ere in Britain. It seems strange that little was done then in the United ates of America but there may have een mistrust of this originally amateur ience among professional astronomers, uch as there was scepticism among ientists of the first serious attempts at cketry.

But there were no doubts in Britain. hree major centres developed in eight ears: at Cambridge, under Martin Ryle; the Royal Radar Establishment, Malern, under Hey; and at Manchester niversity's site of Jodrell Bank in heshire, under Hanbury-Brown and ovell. From the outset they worked gether but they were not alone. There as a parallel and largely British direct- development of radio astronomy in ustralia, and these two areas not only oneered and hammered out the new ience, but still remain pre-eminent.

The first detailed radio maps began take shape less than 10 years ago and nong the first findings was a confiration of Hey's discrete source in Cyg- us. It was the most powerful in the orthern Hemisphere, apparently the ost distant and certainly the most ysterious at that time. The problem as to locate it with sufficient accuracy r it to be identified with some visible oject.

Early radio observations, inevitably uch coarser than those made with otical telescopes (the field of "view" larger and aberrations in collecting rials limit the resolution of single in- ruments) narrowed the field down to out a tenth of a degree, but within at area were many stars and extra lactic nebulae. To overcome this, the ambridge instrument was designed ex- essly to pin-point positions with the eatest possible accuracy. It was not a exible or fast-moving device, but one ade with this need for precise mea- rement uppermost in mind.

In radio astronomy it is possible to e groups of receiving aerials in such way that they simulate a much larger strument than any of the individual rts. Similarly the radio astronomer n use the way radio waves interfere ith one another to determine the dis- nce, or the position, or the size of the ject he is looking at.

The first Cambridge telescope, now perseded by a more powerful and sen- ive instrument, consisted of two iden- al dishes on a railway track 1,000 rds long. Using this baseline the posi- n of the source in Cygnus was de- mined to within a few seconds of arc. is is equivalent to determining the sition of the end of a pencil at a stance of about 12 miles, and the ector of the 200-inch optical telescope Mount Palomar in the United States cided that it justified a new optical rch.

Professor A. C. B. Lovell, Professor of Radio Astronomy at Manchester University and Director of the experimental station at Jodrell Bank. The Jodrell Bank 250ft dish is shown in the background.

The first photograph taken of this area showed a most unusual nebula in exactly the right place. It was a nebula that appeared to have two centres. But, as analyses of the visible spectrum showed, this nebula contained gases in an extraordinary state of excitation. What had been found was not a single nebula but two galaxies in violent collision. From that moment the importance of radio astronomy was fully recognised, for it had demonstrated how rapidly it might add to knowledge, not only of what exists in the universe, but of the processes that are going on.

Increasingly refined techniques, the use of microwave links between Malvern and Jodrell Bank for long-based interferometry experiments, and more precise mapping of areas and sources have revealed a radio sky that is as rich but often more mysterious than the sky we can see. The two do not always match, nor is it yet understood what processes are producing the enormous radio emission energies involved.

Most mysterious of all are the immensely radio bright quasi-stellar objects, the bright radio galaxies, and the

Professor Martin Ryle, F.R.S., shown with the radio telescope at the Mullard Radio Astronomy Observatory, University of Cambridge. The aerial design is similiar in concept to the Mills Cross.

HOLOGRAPHY—THE LOCAL SCENE

The article on holography by Mr E. Laisk in the August issue of ELECTRONICS Australia aroused much interest. Here are some additional comments by the same author, covering the local scene. There is also some background on Professor W. Stroke, of Michigan, currently one of the leading authorities on this subject.

On August 10, in the School of Physics at the University of New South Wales, a seminar on holography was held with demonstrations by the author. A three-dimensional hologram was on display, sent earlier by Professor George W. Stroke of the Michigan University, and is believed to be the first of its kind in Austraila. It is now available for educational purposes.

A simple transmission hologram was also on view, made by Mr R. N. Smartt of the National Standards Laboratory in Sydney.

Holograms were displayed publicly for the first time in Australia, at the 9th International Exhibition of Photography, held in the Sydney Town Hall between August 5 and 17.

Several Australian laser-equipped laboratories are now considering three-dimensional holography. For this, the stability of the laser beam and the resolution of the photographic plate are of primary importance. The holography set-up in the Vehicle Physics Laboratory at the University of New South Wales was designed, originally, as an optical simulator for investigating real time wavefront reconstruction techniques which can be applied to road traffic evaluation, using microwaves.

Holography is applicable to any problem involving the recording or analysis of complex electromagnetic fields and wavefronts such as exist in a microwave-illuminated traffic scene. An extra benefit of the holographic method results from its adaptability for pattern recognition and information storage.

The stability of some of the readily available lasers mentioned in the August article on holography was insufficient for making 3-D holograms. However, they proved adequate for viewing small holograms. For the display of larger ones, the author employed a high-intensity mercury lamp with a filter. A dichromatic sodium lamp, with an optical stop at the local plane of a lens, will produce tolerable definition.

Such coherence problems are no bar in viewing reflection holograms, which Professor Stroke has already been making for several months. When viewed in ordinary daylight, they produce multicolour images of excellent definition by reflection.

Up till now progress has been slow in one branch of holography. Since 1948, many researchers have attempted to achieve immense magnification via X-ray holograms.

Theoretically, a hologram made with X-rays of 0.63A° wavelength provides a magnification of 10,000 times when viewed in a He-Ne laser light of 6328A° wavelength; a further 100 times can be obtained from the distance ratios, which produces a total magnification of 1 million times. In the past, X-rays were neither sufficiently coherent nor monochromatic and could not be easily focused. At the present time, several Mossbauer sources can produce extremely coherent X-rays such as, for instance, the 0.86A° radiation of Fe^{57}. The key problem in X-ray holography is whether sufficiently bright coherent or point sources can be developed for this purpose.

So far, experiments along these lines have met with only limited success, and a great deal of work remains to be done before anything like the calculated magnification is achieved. Nevertheless, the future looks promising.

Professor Stroke

George W. Stroke, Dr. es Sc., is Professor of Electrical Engineering and head of the Electro-Optical Sciences Laboratory at the University of Michigan, U.S.A.

He is a world-wide authority on diffraction gratings and has previously made some notable contributions to the design of the precision ruling engine at the Massachusetts Institute of Technology. This engine has ruled some of the finest 10-inch diffraction gratings in the world. In this field, he is widely known as the author on diffraction gratings in the "Handbuch der Physik." (For reference, see "Diffraction Gratings," ELECTRONICS Australia, July, 1966.)

A strong experimental and theoretical background in interferometry and diffraction made his work in holography an extraordinary success. He has made many important contributions to modern holography, such as white light reflection multi-colour holograms and others mentioned in the article on holography last month in ELECTRONICS Australia. Since 1964, he has been conducting a course in "Optics of Coherent and Non-Coherent Electromagnetic Radiations" in which holography is a main topic.

Professor Stroke is the author of the first book on holography entitled "An Introduction to Coherent Optics Holography" (Academic Press, Inc., 1966). The book includes the complete reprints of the three original "wavefront-reconstruction microscopy" papers of Professor Dennis Gabor (see book review, page 169).

As a comment to the article on holography in last month's ELECTRONICS Australia Professor George W. Stroke writes to us:

"With little more than a continuous-wave laser, some fine-grain photographic emulsions—and the use of well-known techniques of optical interferometry—the 20-year-old method of two-step 'wave-front-reconstruction photography' originated by Professor Dennis Gabor in 1948, has now developed into one of the most exciting and surprisingly fruitful activities in the general field of modern coherent optics." ■

Astronomy

Continued from page 17

strange double source which—altho
firmly pinned on single optical obj
—have strangely shaped lobes of ra
emission. It is generally thought t
radio emission is the result of the ac
leration of high energy electrons in m
netic fields, but how such a mechan
could achieve the fantastic energies
volved is beyond present understandi

The combined work of Jodrell B
and Malvern has recently narrowed
possible angular diameters of some
the quasi-stellar sources to extrem
small limits, but they are clearly
small to be defined within the exis
telescope resolutions. The two 80-
dishes at Malvern (made in Holla
like the Parkes telescope in Austra
are at the moment being modified
as to increase their sensitivity ab
twenty-fold—which should show a f
fold improvement in resolution. Wh
er this will be good enough to give
angular diameter will be known
about a year's time, but it is quite
sible—if quasars are as far away
their optical spectorscopic analysis
gests—that much greater refinement
be needed.

Something of this refinement may
met by the new Mullard Radio As
nomy Observatory instrument at C
bridge, which uses three 60ft
meter aerials on 850yd tracks. These
mounted so that they can be pointed
ward a chosen part of the sky for a
hour period during which the rotatio
the earth carries them round each o
so that they provide a narrow ellipt
strip of coverage. By moving them
successive days adjacent strips can
covered and eventually a pic
emerges that is as detailed as one f
an impossibly large telescope—in
case about one mile in diameter.

Already much more detailed st
tures of some of the radio galaxies h
been published, and new radio sou
much fainter than any discovered hit
to, have been mapped. By studies
different frequencies and diffe
direction of rotation of radio waves
these like light can be polarised) it
in time be possible to understand
way in which the radio signals are g
rated.

No one can predict what lies ah
but radio astronomy has already ta
us to greater depths in the univ
than any other observational techni
It has also taken us more deeply
the sun and populated the recesse
space with new mysteries, new pos
lities and demonstrations of en
generation which are not within e
ing physical conceptions. It has
solved some mysteries, like that
Cygnus A, with an elegance that w
have seemed impossible only 20 y
ago.

What it cannot do is tell us
far away the most distant objects
and the velocity with which they
moving. But, without any doubt, r
astronomy is the science which, in
end, will settle the interminable
philosophically important argument
cosmology. Indeed, in 20 years, it
gone a long way toward turning ma
matical cosmological philosophy int
observational and experimental scie
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ite for EMQ's. Models 401, Lab 80 and ers are now in stock.

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onveniently situated on the Ground Floor f the 2SM Building at 257 Clarence Street, ıe new Encel Stereo Centre in Sydney is roaring success. Many exclusive Encel ines are available for the first time in Syd- ey . . . and there can be little doubt ıe range of audio equipment available is the idest in N.S.W. **A Sydney Service Dept.** as been established to provide speedy and fficient service if ever necessary. All quipment is BRAND NEW and FULLY UARANTTED. The telephone number is 9-5160.

SPECIAL INTRODUCTORY OFFER ON MICRO EQUIPMENT!

"Micro" tone arms and cartridges are olutely outstanding in their respective cate- ies . . . the MA77 tone arm was reviewed "Electronics Australia," pages 126-127, ruary, 1966. The same pages carried reviews two Micro cartridges, the SC 301 (ceramic) the M-1007 (magnetic). The MA77 arm the stereo diamond stylus cartridge M-1007 for £stg26 in the United Kingdom. Encel cial Introductory Offer includes both items **only $47 (£A23/10/)! IMPORTANT:** 100 77 tone arms and 100 M-1007 cartridges have ı reserved to meet the expected heavy de- ıd. Write or call now!

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Philips, Grundig, Stenorette, Olympia.

TONE ARMS AND CARTRIDGES

ADC, Ortofon, Micro, Nikka, All Balance, JH, Pritchard, Decca, Leak, etc.

TURNTABLES

Garrard, Lenco, Orpheus Silex, JH, Labcraft, Thorens, Dual, P.E., etc.

LUXOR TAPE RECORDERS

Regarded as one of the Continents leading tape recorders, LUXOR is now distributed in Australia by Encel Electronics Pty. Ltd. Illustrated is the new model MP464, a four track-three speed recorder with a frequency response of 50-19,000 c/s (at 7½ ips). Pick-up sens. is 100 mV microphone sens. is 7 mV for mono or stereo microphones. Write for complete specifications and price. This LUXOR stereo recorder has been favourably reviewed overseas — and is now available in Australia for the first time. Other LUXOR models will follow. Frequency response of the MP464 is substantially linear-varying only plus or minus 3db.

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The new model "Celeste" with the improved Super Tweeter is now on display in all Encel Stereo Centres. Write for an EMQ! .

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The special offers made from time to time by Encel Electronics in "Electronics Australia" (Page 15) are often kept open for several months. In many cases, the prices quoted are still applicable. Please check with us!

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Computers Join The Armed Services

A country's armed services are normally among its largest and most complex organisations, even in times of so-called peace. The complexity of modern military equipment, with its need for spares and maintenance, alone creates a colossal task, while finance, health and similar records add up to a huge accounting job. Little wonder that armed services everywhere are turning to computers for assistance.

In the past few years, the major lerical processes of the Australian rmy have been undergoing a quiet ut far-reaching revolution.

The clerical task of the Army is reater than it has ever been before xcept in time of war and. with the perational commitments in Vietnam nd Borneo and the rapid development f National Service, there is a vital and rowing need for prompt, concise, ccurate information for planning and anagement control purposes.

This is particularly true in the supply eld. With hundreds of thousands of ifferent items of stores and equipment, network of major stores depots, widepread deployment and usage of suplies and the growing complexity of quipment coupled with mounting operaonal demands, the purchase, distribuon and control of stores and equipment ave assumed increasing significance. he payroll task has also expanded onsiderably to cope with the expandg forces on world-wide service and e demands of a modern pay system, d its associated personnel records.

In recent years these tasks and many sociated routines have been converted om largely manual systems to higheed centralised electronic systems in eparation for the integrated electronic ta processing scheme planned to cover e Defence Department and all three rvices.

A centralised Data Processing Instaltion was set up at A.H.Q. Albert rk Barracks, Victoria, as a unit cord Service Bureau for the Departent of the Army in April 1962, with e second largest installation of conntional punched card equipment in stralia. This was done with the aim progressing gradually from a manual stem to an efficient unit record system, n through a medium scale computer stem and finally to large scale elecnic data processing. The present ase of development is to completely lace the unit record installation by a rroughs B 283 Computer System.

t was found in the latter half of 3 that the data processing requirents of the Army had expanded ond the capacity of the conventional t record installation and that addial capacity was necessary. Investigas at that time showed that it was re feasible to replace the tabulating l calculating element of the unit ord equipment by a medium scale computer — which could maintain the huge card handling capacity required — than to expand the unit record capacity of the centre.

To this end a Burroughs B 260 was installed in January, 1964, comprising:—

Two 800 card per minute card readers.
One 300 card per minute card punch.
One 700 line per minute printer.
One 4800 character core memory central processor.

Within six months of the Burroughs installation it was possible to return the majority of the unit record equipment it was to replace, and the total replacement was fully realised within nine months Conventional punched card equipment replaced by the B 260 included:—

One Plugged Program Electronic Calculator.
One Plugged Program Electronic Multiplier.
Four Plugged Program Tabulators.
One Collator.
Two Sorters.

After eighteen months use of the B 260 on a single shift operation, with a throughput of 3-4 million punched card per week, spread over 300 programs with an average size of 270 instructions, it then became obvious that in order to progress there was a need to transfer the medium of data storage from punched card to a more economical form.

To achieve this end it was proposed to add to the Burroughs configuration an additional 4800-character memory module, four B 422 Magnetic Tape Decks with a transfer rate of 66,000 characters per second, and one B 141 1,000 character per second paper tape reader. These additions amounted to upgrading the B 260 system to a B 283 system.

All this was to take advantage of the process of being able to produce paper tape as a by - product output from accounting machines and Flexor writers in various branches of the Army, instead of converting immediately to punched cards as previously.

In operating as a data processing Service Bureau for the Department, the installation in Albert Park carries out processing for many branches. Normally, each branch is equipped with a data originating machine — either punched card, paper tape, or magnetic tape—on which the branch's records are updated as various transactions are completed within its area. At suitable intervals the cards or tapes are transferred to the Central Data Processing Centre, to update the central records.

A summary of these tasks is set out as follows:—

1. Ordnance Services:
   (a) Maintain a file of details of centrally procured stock items showing the present stock holding as quoted on paper tape produced as a by-product of hard copy posting in the Ordnance Depots. In addition, this file shows the cumulative issues of each item since the last provisioning review carried out on the item. Volume equals 200,000 active items.
   (b) Carry out periodic provision reviews by class of items, advising liability deficiencies or surpluses based on issue history. Requote reorder levels based on current usage rates.
   (c) Produce warning advices when stocks quoted fall to re-order levels. This is done weekly.
   (d) Maintain a file of the current position of all items on order by order number.
   (e) Produce punched card replenishment requisitions for direct input

The IBM B 260 system, used in the initial stages of the Army's transition from a simple unit record installation.

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into U.S. Army computerised supply system.
(f) Maintain equipment tables for the various branches of the Army.
(g) Produce punched cards as amendments to catalogue data from paper tape.
(h) Produce stock census statistics and general management statistics.

Army Pay Accounting Centre:

(a) A wide range of complex and heavy volume applications are carried out on the equipment for the Army Pay Accounts Centre, wherein the pay and allotment accounting for all members of the Australian Permanent Military Forces is contained. Only a few of the major pay applications are recorded below.

(b) **Application No. 1** controls the pay and allowances of members of the Permanent Military Forces. Over 100,000 pay variation advices are prepared each year and are forwarded to Army units throughout the world as the basis of payroll preparation. The application for each variation involves updating a set of three punched cards from variation cards punched in the Army Pay Accounts Centre; the editing of updated cards to ensure the accuracy of data shown thereon; the printing of a pay variation advice for the Army Unit showing a complete rewrite of current pay history data, and the cutting of a by-product card to be used as variation input in Application No. 3 below. Simultaneous use of a card reader, central processor, and line printer and card punch is involved in each run.

c) **Application No. 2** controls the balancing and analysis of pay transactions in Army Units. Over 1,000,000 transactions per annum are encompassed in this application which controls millions of dollars of defence expenditure. The simultaneous use of a card reader, central processor and line printer is involved in this run.

d) **Application No. 3** controls fortnightly pay entitlements for all members of the Permanent Military Forces. Each fortnight all pay entitlement cards are updated, based on variation cards ex application No. 1; and transaction cards ex application No. 2; a summary is produced for management purposes, and updated cards are cut as input for the following fortnight. A multiplicity of complex checks are carried out by the central processor during each run to detect and highlight accounting errors made in Army Units. This application involves over 2,000,000 cards per annum and requires the simultaneous use of both card readers, central processor, line printer and card punch.

) **Application No. 4** controls allotment payments to all banks and insurance companies throughout Australia totalling $1,000,000 per fortnight. A set of two cards for each allotment involved together with a series of control cards are processed to obtain schedules of allotment payments, and individual allotment records for subsequent incorporation in bank accounting systems. The central processor and line printer are used in this application.

The next development of the Army's computer system was to upgrade the B 260 system to a B 283, shown here.

(f) **Application No. 5** controls data required for taxation purposes. Each fortnight, tax cards are updated on the basis of variations processed during the fortnight, a taxation ledger summary is produced, and updated cards are cut for input the following fortnight. Under this system taxation group certificates may be produced at any point in time. At the end of the tax year, taxation group certificates are printed from tax data shown on tax cards coupled with that emitted by the central processor during the passage of cards. This activity encompasses about 1,000,000 transactions and requires the use of both card readers, central processor, line printer and card punch.

(g) **Application No. 6** controls allotments paid through post offices throughout Australia. Books of stub cards, to be used as computer input when negotiated, are produced for issue to Postmasters. Negotiated stub cards are processed with entitlement variation cards and ledger cards each fortnight to obtain ledger summaries and updated ledger cards to be used as input in subsequent runs. This application involves over 500,000 transactions per annum and requires the use of both card readers, central processor, line printer and card punch, with peripheral conventional punched card equipment.

(h) **Application No. 7** involves cross reconciliation between punched card records. These checks involve over 1,000,000 card passages per annum and the use of both card readers, central processor and line printer.

3. **Army Records Office — Personnel Statistics**
   (a) Prepares monthly, quarterly, half-yearly and yearly statistical tables concerning manpower strength and establishment figures of the Australian Military Forces for distribution throughout the Army and other Government Departments.
   (b) Prepares other statistical tables on an "as required" basis.
4. **Electrical and Mechanical Engineering Statistics**
   (a) Maintains statistics of workshop repairs for monthly, quarterly and annual output.
5. **Electrical and Mechanical Engineering Instructions**
   (a) Prepares address advices of units requiring Instruction Manuals when issued for various subjects.
6. **Army Health Benefits Society**
   (a) Reconciles approvals against presented cheques.
   (b) Produces statistical data as required.
7. **Psychology Corps**
   (a) Processes calculation of correlation co-efficients and other statistical variables on test results collected.
8. **Dental Corps**
   (a) Processes calculation and tabulation of statistical surveys.
9. **Staff Duties**
   (a) Prepares various statistical tabulations of personnel establishments

The foregoing are only some of the tasks successfully carried out by the Burroughs B 260 configuration, and further tasks are planned for the magnetic tape/paper tape system which has recently been installed. As well as modernising many clerical processes the Machine Data Processing Centre has brought about centralisation of major activities and produced invaluable computer experience and systems review in preparation for defence-wide electronic data processing. ▣

LARGEST COMPUTER FOR MELBOURNE

Because of rapidly increasing workload, the IBM Scientific Computing Centre in Melbourne will install the biggest IBM System/360 in Australia, in November this year three months ahead of schedule.

The machine, a Model 50, worth over $A1 million, will take over the work previously processed for the Scientific Computing Centre on an IBM 7044 System. Because of its large data storage capacity—nearly twice that of the 7044—and its advanced technology, the Model 50 will be capable of processing much bigger problems, quicker, for the S.C.C.

Australian engineering, scientific-industrial and Government organisations requiring computing facilities will be able to use the new machine.

The cost of S.C.C. services may vary from a mere $20 for a one-time application to $10,000 over a period of several months.

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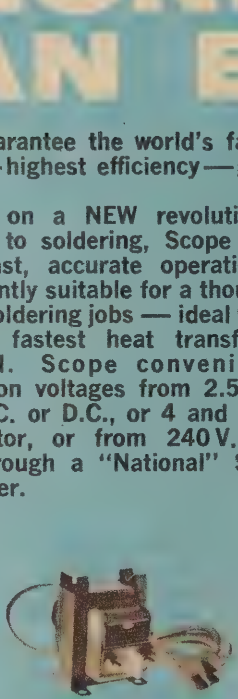

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SPASTIC WORKERS MAKE PRECISION PARTS

. . . for telecommunications industry

A unique experiment in the employment of people handicapped by cerebral palsy (spastics) is being conducted by the Spastic Centre of N.S.W. in the Sydney suburb of Allambie Heights. A company, Centre Industries, has been formed to make telecommunications equipment components, in which nearly one third of the work force are spastics.

The only enterprise of its kind in the 'orld, Centre Industries operates on trict commercial lines and is a member f the Australian Telecommunications)evelopment Association, a division of he Chamber of Manufactures of N.S.W. Vorking in the plant are more than 00 spastics, adult cerebral palsy victims, 'ho operate complicated machines turn- ig out precision parts for telecommuni- ation equipment.

Centre Industries does not operate as sheltered workshop. The spastics work nd mingle with nearly 400 able-bodied o-workers, sharing the same canteen nd other facilities. Operating in a ighly competitive industry, Centre ıdustries is not afforded any special onsideration when it comes to contracts. ll of its contracts are won by competi- ve tendering, in which the only con- derations are quality, price and deli- ery.

The factory's main products are com- eted relay sets for automatic telephone xchanges. It manufactures approxi- ıately 2,000 of these per month and s many as 70 different types per month. ther products include relay sets for mote control of power-generating ations, traffic signalling systems, private ıtomatic exchanges, control units for leprinters, amplifiers, electronic testing uipment and circuit modules of the ug-in type, as well as relays of various pes for the telecommunications indus- y.

A rigid quality control system cover- g every phase of production ensures at all equipment meets the exacting ecifications set by the Post Office and her discriminating users.

The P.M.G.'s Department is the com- ny's best customer, but equipment is so manufactured for the Department Supply, the Department of Civil Avia- n, the Snowy Mountains Hydro- lectric Authority, Electricity Commis- ns and other similar authorities in States.

Centre Industries has also built up modest export business to New Zea- nd, Hong Kong and Thailand—and is rrently planning moves to increase port earnings.

Centre Industries was established in 61 to provide useful employment for astics who had completed their educa- n and therapeutic treatment at the astic Centre of N.S.W. at Mosman. was the start of an experiment, which ved successful beyond all expecta- ns.

The work of Centre Industries has eady achieved world renown and the nt has become a Mecca for medical l rehabilitation specialists from over- s, who are all most enthusiastic at results attained by the training and rehabilitation methods presently employed. In 1964, Centre Industries won an international award for "helping the handicapped to help themselves."

The plant's commercial manager, Mr Bert Israel, said: "It is our duty and responsibility to train the cerebral-palsied so that they may obtain the very maximum measure of independence with dignity.

"You must remember that there is no textbook approach to this problem and that we have barely scratched the surface. But we are applying an elaborate, methodical and scientific approach and it may be that, in the course of the next two years, we will come up with a pattern that can be successfully applied elsewhere in the world."

The training of the spastics is spread over several stages. Some are under elementary training, others are working in more forward training areas, and those who have gone through these stages are engaged in full production.

A section of the young adult trainig unit at Centre Industries.

The spastics arrive at Centre Industries at 16-18 years of age, with a multiplicity of handicaps. Most have to cope with speech and hearing defects as well as lack of muscular control.

In their elementary stage of training, they are indoctrinated in factory atmosphere with its attendant routine of activity, noise, repetitive effort and discipline, etc. They are given the most elementary tasks until their disabilities are work-studied and analysed. This work-study analysis is a continuous process, records being kept of the progress of each individual. From the elementary training phase, the spastics move from stage to stage in complexity of operations until they graduate into partial or full-time production.

They are trained in foot, hand and power press operations, drilling and tapping operations, all types of lathe activities, plastic moulding and many forms of assembly work. Some of them, more readily adaptable to office procedures, are trained in clerical and business machine operations and other office activities. The switchgirl, for example, is a spastic, while others are handling materials and stores functions.

The overall efficiency level in the machine shop has risen to 70 per cent, achieved from a starting level of 17 per cent at the training stage. The spastics are paid by output, measured in terms of the efficiency of able-bodied workers.

While the factory is run on highly efficient lines, very little automation has been installed—the reason being that, because of the training commitment, it is most desirable to use plant which calls for the maximum use of hands and feet. By this means, the therapeutic value of hand and limb movement is not lost. The long-term goal is to train these people for outside industry and, already, several have passed into other jobs.

Since its inception, Centre Industries has made a profit each year—but this has been ploughed back into an expansion of training and other facilities. One new amenity at present under construction is a specially equipped gymnasium.

However, overheads are high, with Spastic Centre buses bringing the spastics to work from all over the metropolitan area and returning them to their homes in the evening. Moreover, one unit of the factory operates a brace shop to design and manufacture orthopaedic and other special aids, which are supplied free of cost to the cerebral palsied.

There is, of course, a long waiting list for employment in the factory—but, at the present rate of expansion, 15 to 20 spastics will be taken in each year. ■

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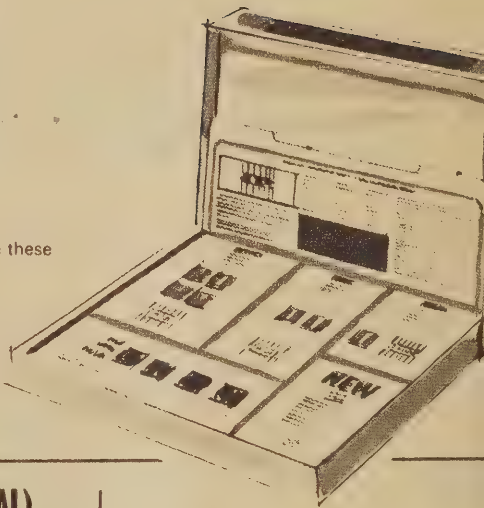

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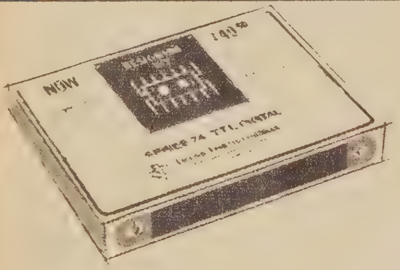

SERIES 74 TTL (DIGITAL)

- ★ High speed saturated logic, low power dissipation
- ★ High noise margin, high fan-out
- ★ Available in flat pack and industrial pack

Integrated Circuits	**Value**
One SN7420 Dual 4-input positive NAND gate	$5.70
Two SN 7450 Dual EXCLUSIVE —OR gates with expander inputs	14.20
Four SN7470 Single-phase J-K flip-flops	35.60
Breadboarding Sockets	
Four MPC-1 14 pin Mech-Pak Sockets	16.00
Total value	$71.50

SPECIAL INTRODUCTORY PRICE. $49.50

TYPICAL CHARACTERISTICS

Parameter	Basic Gate	Flip-flop
Propagation delay	13 nsec	40 nsec
Power dissipation	10 mw	60 mw
Fan-out	10	10
D-c noise margin	1 v	1 v
Supply voltage		
Series 54	4.5 to 5.5 v	4.5 to 5.5 v
Series 74	4.75 to 5.25 v	4.75 to 5.25 v
Temperature range		
Series 54	55 to 125 C	55 to 125 C
Series 74	0 to 70 C	0 to 70 C

Sample Applications

- ★ 4-bit Binary to Gray-code Converter
- ★ 4-bit Binary Comparator
- ★ Divide-by-5 Counter
- ★ Binary Coded Decimal Counter

The full range of 74 series High Speed Digital integrated circuits has now been expanded to include the following circuit functions.

Type No.	Circuit Functions	✻1-24
SN7400	Quadruple 2-input Positive NAND Gate	$6.50
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SN7420	Dual 4-input Positive NAND Gate	5.70
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Type No.	Circuit Functions	✻1-24
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SN7460	Dual 4-input Expander	5.20
SN7470	Single-phase J-K Flip-flop	8.90
SN7472	Single Master/Slave Flip-flop	7.30
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SN7474	Dual Latch	11.40
SN7480	Full Adder	14.30
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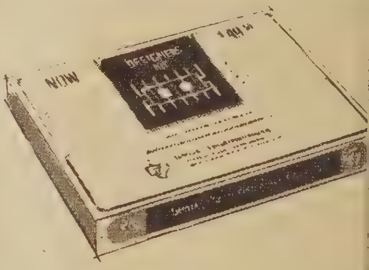

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One SN723 General purpose differential amplifier	$27.6
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Breadboarding Sockets	
Two MPC-1 14-pin Mech-Pak sockets	8.0
Total value	$84.2

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Sample Applications

- ★ Variable gain—a-c amplifier
- ★ Stable gain circuits
- ★ Isolation amplifiers (buffer)

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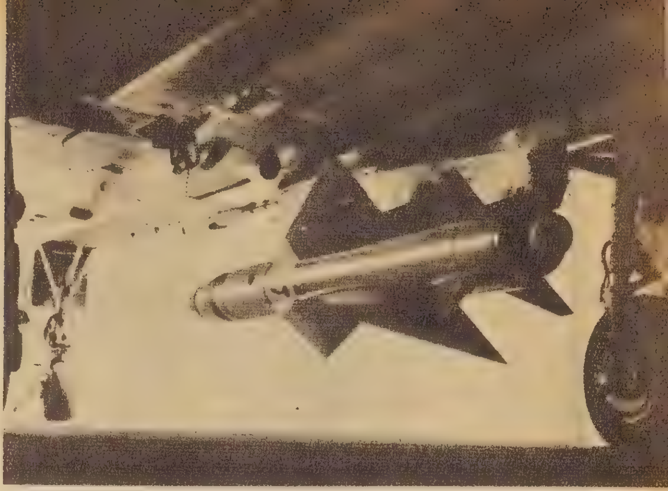


An R.530 missile of the type supplied by Engins Matra to the R.A.A.F.

Outside France, few members of the general public have heard of Engins Matra, the French company which has supplied a large number of its R.530 missiles to the R.A.A.F. Yet this comparatively unknown company has achieved a unique place in the field of aircraft armament.

n addition to supplying the R.A.A.F.,
;ins Matra makes launching pods for
: types of rocket used in French,
ish, U.S.A. and Swiss aircraft.
pecialisation is the key to the com-
y's success in this field of operation.
;ins Matra has specialised in air-
t armament systems and missiles in
post-war years, and now claims to
: the world's largest range of rocket
icher systems.
or example, Matra underwing laun-
s are fitted to the Dassault "Mystere
A" and "Super Mystere B 2," also
ud Aviation's "Vautor." The Type
M launcher used in the Fiat G91
developed specially by Matra.
oneycomb rocket launchers have
developed in a wide variety to
planes such as the "Super Mystere
" the "Vautour" and the U.S. F 84F
Corsair, as well as for helicopters
as the Alouette II and III.. Matra
plastics and other lightweight
rials to make these launchers
omical and expendable after use.
design, the Type 116 launcher,
es nineteen 68mm rockets fired in
re-selected order to avoid inter-
ice effects, at a rate of 1,500 rounds
minute. This equipment is fitted to
'Super Mystere B 2," the F 84F and
air, etc. Type 361, holding 36
B 37mm rockets with folding fins,
signed for subsonic planes such as
ireguet "Alize" and for the Alouette
id III helicopters. The firing rate
ype 361 is 900 rounds per minute.
more specialised launcher is the
RA-GAM DJL 100 R, carrying
:en SNEB 68mm rockets. An
o-mechanical distributor, the rate
iich is controlled by an electronic
vibrator, provides single-shot, con-
is burst, and bursts of 3 or 6
ts.

n-expendable launchers are distin-
d by a pointed penetration cone,
isure minimum drag. Five types
iade by Matra, including the 36
which is being manufactured in
Britain under licence by Thomas
h and Sons in the No. 7 Mk I
n for the Hawker Siddeley "Buc-
." It carries 36 two-inch rockets
igle shot or burst firing at a rate
)0 per minute.

Matra also makes bomb-bay rocket launchers, fully automatic in action, for Dassault's "Mystere IV," Sud-Aviation's "Vautour" and others. When the pilot presses the On/Off switch, the launcher lowers to "Emergency" position (one row of rockets out) and the bottom rockets break the foam plastic trap-doors. Rockets are fired in one or several salvoes according to the duration of action on the firing trigger. When firing is complete, the bottom of the rack fits the fuselage skin of the aircraft, thus replacing the trap-doors.

Two types of bomb-rocket launchers are made, Types 36 and 38, for firing rockets or dropping bombs. This equipment is mass-produced, particularly for the Breguet "Alize" (type 36) and the Macchi MB 326 B (type 38).

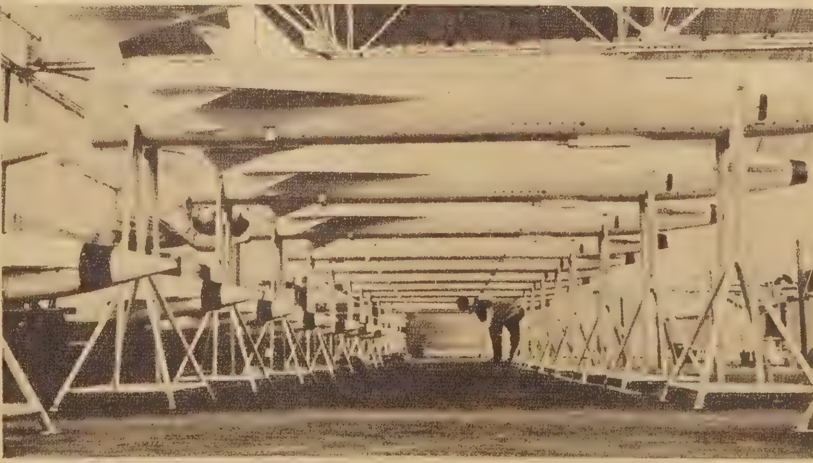
Engins Matra is actively engaged in the French space rocket program, and has already made meteorological sounding rockets for the French National Meteorological Office.

The company has been associated with S.E.R.E.B. (a French organisation concerned with the development of a ballistic engine for space purposes) in the development of the "Rubis" VE 210 D, designed as the test vehicle for a number of the components of the "Diamant" satellite launch vehicle, which forms the major part of the current French satellite program.

Matra is responsible for the interstage section between stages 2 and 3 of the "Diamant." This section holds guidance equipment, programmers, switching for the pyrotechnic devices, and telemetry equipment.

The experimental "A1" satellite structure was built by Matra and put into orbit on November 26, 1965 by the "Diamant" rocket from the French launching base at Hammaguir (Sahara).

Matra operates a Space Department, which is at present studying passive stabilisation of space vehicles by gravity gradient and the terrestrial magnetic field; and stabilisation by gas jets. The firm is working on an attitude control device for three-axis control, using fixed micro-jets, supplied from a compressed nitrogen pneumatic system, comprising two spherical reservoirs at high pressure and a toroid distribution chamber at low pressure, feeding sets of electrovalves. Information from the attitude detectors is fed in to control the servovalves. The equipment is designed for the "Diamant," on the skirt of the second stage, to provide tilting of the second and third stages prior to staging and then rotation of the third stage. ■



One of the largest air-to-air missiles made by Engins Matra is the Type R.511, seen under construction here at the company's factory.

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MULTIMETER RANGES:

DC VOLTAGE:
0-2.5 volts)
0-10 volts)
0-50 volts) — 20,000 ohms per v
0-250 volts)
0-1000 volts)

AC VOLTAGE:
0-2.5 volts)
0-10 volts)
0-50 volts) — 8,000 ohms per vo
0-250 volts)
0-1000 volts)

DC CURRENT
0-50 microamperes — 250 millivol

0-0.5 milliamperes)
0-5 milliamperes)
0-50 milliamperes) — 150 millivol
0-250 milliamperes)

DC RESISTANCE:

Range	—RX1	RX10	RX100	50 Mohm
Midscale	—74-ohm	740-ohm	7.4k-ohm	434k-ohm
Minimum	—1-ohm	10-ohm	100-ohm	10k-ohm
Maximum	—10k-ohm	100k-ohm	1 Megohm	50 Mego
II	—20ma	2ma	0.2ma	

VOLUME LEVEL: —10db—+10db on AC 2.5 volt range
+5db—+36db on AC 50 volt range

ALLOWANCES:

DC voltage:	± 3% at full scale deflec
AC voltage:	± 4% at F.S.D.
DC current:	± 3% at full scale deflec
DC resistance:	± 3% of full scale length

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Technical Review

COMPUTER INDEXING OF TECHNICAL REFERENCES

Computers are now being used to help scientists and engineers locate specific and technical articles from among the many thousands published each year. This article from a recent issue of "Electronics" explains some of the systems developed for this purpose.

In a few weeks, scientists and engi-eers at Bell Telephone Laboratories ill get a new daily service as welcome s a coffee break. Every day, each tech-ical employee interested in mathematics nd the computing sciences will receive copy of all internal technical memos ritten in those fields. In time, this rvice will cover all technical areas.

This helpful time-saver will be andled by a minimum of personnel. very day, certain details of each new emo will be fed into a computer and ere matched against a profile of the eds of each employee who gets the rvice. Then, the computer will desig-ite which papers go to whom, print it the distribution list, and even address e labels. Abstracts or complete copies the memos, according to the nployee's preference, will then mailed to those on the computer-epared list.

The new service will be in addition one that Bell Labs has been operating r several years. The computer now ints a permuted title index, as illus-ted below and described overleaf. all internal memos and papers written Bell Labs technical personnel. This index is prepared monthly and mailed to all scientists and engineers in the laboratory. Another index of papers and articles written by people outside the laboratories is now manually prepared and distributed twice a month.

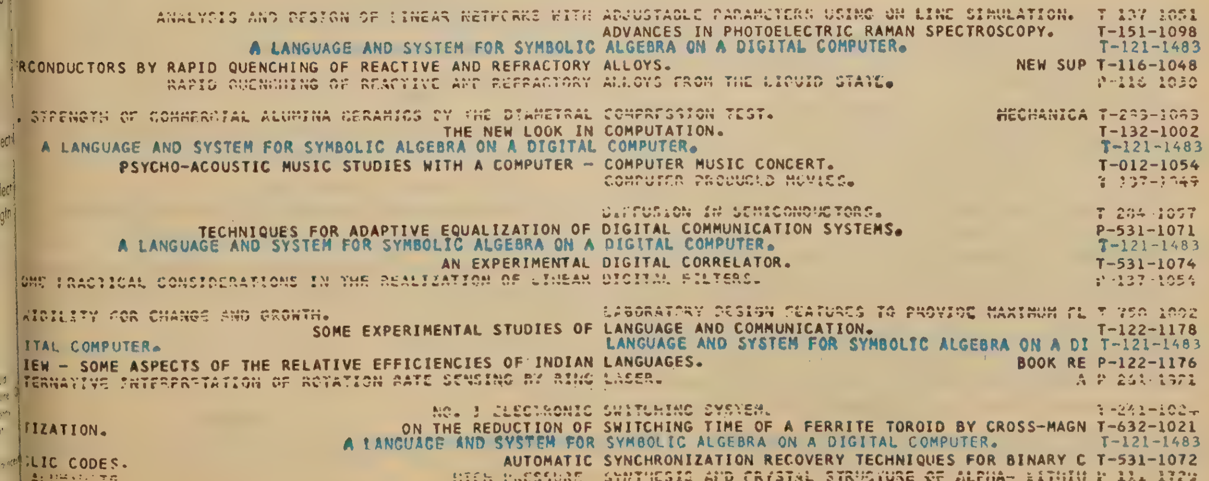
Within a year, the outside index will also be prepared by the computer together with a cover letter for each employee getting the index. The cover letter will tell him what he should look for in the index.

In time, Bell employees will be able to ask their information-retrieval system to search for material on complicated combinations of subjects with a number of delimiters, or restrictions. For example, he might ask for a list of papers that deal with the effect of microstructure on the transition temperatures of intermetallic superconductors. He might say that he wants all authors except those who work for the XYZ Co., because he is familiar with their work; he wants nothing written prior to 1960; nothing in Italian or Japanese, because he can't read either language; and nothing from certain technical journals. He might also stipulate that he is mainly interested in papers dealing with the theoretical aspects of the subject rather than experimental or state of the art work. Then, he might tell the computer that if the list reaches 100 papers it should let him know before it begins printing out the titles, so he can specify more delimiters.

Bell is only one of the many companies and government agencies creating information retrieval systems. Every year, approximately 100,000 technical journals are published in the United States and abroad; the U.S. Government issues about that same number of studies each year, as well as some 450,000 articles and papers. Scientists find that keeping up with material in their fields is an impossible task.

Present computer systems are limited to compiling indexes of documents, rather than storing copies of the documents themselves. The computer produces an index arranged by title, author, subject or any other classification; some systems also store abstracts of indexed items.

There are two basic approaches to indexing: controlled vocabulary, which



Permuted title index used at Bell Telephone Laboratories. The index is an alphabetical listing of titles, with each title entered separately under each significant word in its paper. Lines in color are entries listed under several key words.

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          ANALYSIS AND DESIGN OF LINEAR NETWORKS WITH ADJUSTABLE PARAMETERS USING ON LINE SIMULATION.  T 137 1051
                                                      ADVANCES IN PHOTOELECTRIC RAMAN SPECTROSCOPY.     T-151-1098
                   A LANGUAGE AND SYSTEM FOR SYMBOLIC ALGEBRA ON A DIGITAL COMPUTER.                    T-121-1483
RCONDUCTORS BY RAPID QUENCHING OF REACTIVE AND REFRACTORY ALLOYS.                               NEW SUP T-116-1048
              RAPID QUENCHING OF REACTIVE AND REFRACTORY ALLOYS FROM THE LIQUID STATE.                  P-116 1050

. STRENGTH OF COMMERCIAL ALUMINA CERAMICS BY THE DIAMETRAL COMPRESSION TEST.                  MECHANICA T-293-1093
                                          THE NEW LOOK IN COMPUTATION.                                  T-132-1002
 A LANGUAGE AND SYSTEM FOR SYMBOLIC ALGEBRA ON A DIGITAL COMPUTER.                                      T-121-1483
          PSYCHO-ACOUSTIC MUSIC STUDIES WITH A COMPUTER - COMPUTER MUSIC CONCERT.                       T-012-1054
                                                      COMPUTER PRODUCED MOVIES.                         T 137-1049

                                                      DIFFUSION IN SEMICONDUCTORS.                      T 204 1057
                 TECHNIQUES FOR ADAPTIVE EQUALIZATION OF DIGITAL COMMUNICATION SYSTEMS.                 P-531-1071
        A LANGUAGE AND SYSTEM FOR SYMBOLIC ALGEBRA ON A DIGITAL COMPUTER.                               T-121-1483
                                         AN EXPERIMENTAL DIGITAL CORRELATOR.                            T-531-1074
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XIBILITY FOR CHANGE AND GROWTH.                       LABORATORY DESIGN FEATURES TO PROVIDE MAXIMUM FL T 750 1002
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ITAL COMPUTER.                                        LANGUAGE AND SYSTEM FOR SYMBOLIC ALGEBRA ON A DI T-121-1483
IEW - SOME ASPECTS OF THE RELATIVE EFFICIENCIES OF INDIAN LANGUAGES.                           BOOK RE P-122-1176
TERNATIVE INTERPRETATION OF ROTATION RATE SENSING BY RING LASER.                                     A P 251 1371

                                       NO. 1 ELECTRONIC SWITCHING SYSTEM.                               T-241-1024
TIZATION.                          ON THE REDUCTION OF SWITCHING TIME OF A FERRITE TOROID BY CROSS-MAGN T-632-1021
                          A LANGUAGE AND SYSTEM FOR SYMBOLIC ALGEBRA ON A DIGITAL COMPUTER.             T-121-1483
LIC CODES.                                      AUTOMATIC SYNCHRONIZATION RECOVERY TECHNIQUES FOR BINARY C T-531-1072
ALUMINATE.                                  HIGH PRESSURE SYNTHESIS AND CRYSTAL STRUCTURE OF ALPHA- LITHIU P 111 1729
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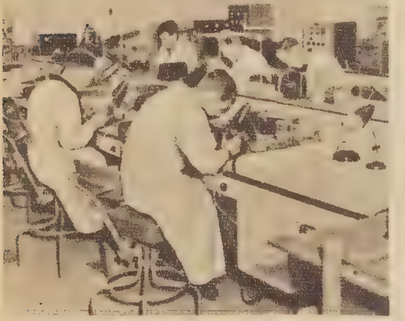
APPRENTICESHIPS IN THE RAAF

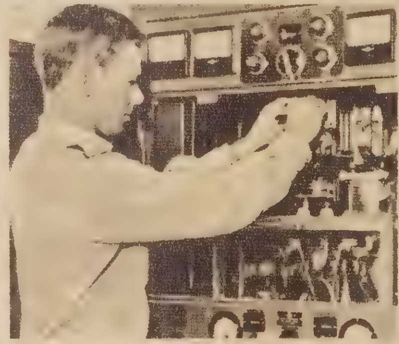
Engines. Engine Fitter pictured at work checking equipment inside a Sabre jet.

Electrical. An N.C.O. Electrical Fitter instructs Electrical Servicemen in the operation of the voltage regulator test bench.

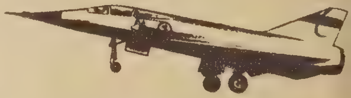
Armament. Armament Fitters fitting a 30 mm. Aden Cannon to a mock-up of a Sabre fighter.



Instruments. Instrument Fitters reconditioning aircraft gyroscopic equipment at No. 2 Aircraft Depot, Richmond, N.S.W.



Radio. Radio Technicians (Ground) adjusting 3-Kilowatt high-frequency transmitter.



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quires preliminary screening and ssification of documents by someone o can understand them, and the un- ntrolled-vocabulary approach, which ults in a greater number of titles ng loaded into the computer's mem- by relatively unskilled clerical per- nnel.

All controlled-vocabulary systems re- ire a thesaurus which contains all the words and several synonyms for ch, all extensively cross-referenced. It accessible to the computer and to the ofessional compiler, but not to the er of the system.

The uncontrolled-vocabulary approach ts a heavier burden on the engineer ng the system; he must know rather ecisely what he wants when he re- ests a search.

An example of the uncontrolled- cabulary approach is the Kwic index, ginated at International Business chines Corp. and used by several ganisations. Kwic stands for Key Word Context. Titles of documents are ered into the computer, together with serial number that also identifies the eral subject of the document and its e; also recorded are the author's ne, the publication, and an abstract. e computer lists each item in numeri- order; it can then generate author ices or other types of indices based data in its memory.

he principal feature of the Kwic ex is its permuted title listing (see re 1). It lists each title several times, e for each significant word in the . The listing is printed with the ificant words aligned alphabetically n the middle of the page and the ainder of the title to the right. If entire title cannot be contained in half-line, then it is continued at the . If even a full line cannot contain title, the overflow is omitted with lash to show the omission.

BM makes little use of the Kwic x which is not suited to the gigantic mes of data now handled by the I Technical Information Retrieval tre. Some groups within IBM have lified Kwic to Kwoc, for Key Word of Context; Kwoc, basically a sub- index puts the key word in the margin.

resent information-retrieval systems search for documents but generally for specific facts. For instance, a can say, in effect "Get me the r by John Johnson on tunnel diodes ished about six months ago," and computer can give him the specific ors, the exact title, the book maga- or journal in which the paper ap- ed and perhaps an abstract of the r. Or the user can say "I want all papers that deal with high-voltage r supplies, but not those using um tubes, nor voltages above 500."

Some systems can find some kinds of ; IBM's Iris (for IBM Recruitment mation System) personnel informa- system, for instance, can give the s of all engineers in the company have masters' degrees from mid- rn universities, or who have specific ience in the field in question.

t no current system can search for swer to a question such as, "How bilised voltage gain related to for- gain and per cent feedback?" The eer with such a question would to remember that he saw the r in an article about feedback in Electronics early in 1966, and ask the computer to find that article. The computer could reply, "Electronics, Jan. 24, 1966 p. 66."

Some prototype systems being developed permit such fact retrieval but full realisation depends a great deal on improved knowledge of linguistics, or the science of meaning. This is the same problem that blocks computer translation of language.

The most efficient computer system for an information retrieval application include direct-access equipment such as magnetic disc files or large magnetic drums. But some systems rely on serial-access magnetic tape. With direct-access equipment, information stored at any location is accessible within milliseconds; in discs, this time is determined by mechanical motion of the read-write heads and by the time of rotation of the spinning discs. Magnetic tapes are serial-access, because to reach data at the centre of a reel of tape the computer must read all the data from the outside in, a process that takes four to five minutes. Some systems use tape because of the experimental nature of the system, the cost of direct-access equipment, or because the only available computer system is one that was not set up specifically for information retrieval.

The ultimate information retrieval system may be a national network. Government and private enterprise are trying to develop such a system, but much of the financing will be federal — for several reasons:

- The Government is the source of much of the information that is to be retrieved.
- A Federal agency might be a suitable co-ordinator of activities among various private enterprises.
- Government agencies are as interested as any other organisation in retrieving information out of the mass of generated data.

One preview of the retrieval system of the future may be project Intrex (for Information Transfer and Exchange) at the Massachusetts Institute of Technology. Intrex is concerned with storing copies of documents, rather than references to them.

Experiments conducted in Project Intrex include one aimed at developing a means of augmenting the traditional card catalogue, with electronics, to extend the indexing capabilities of cards.

Related studies in Intrex are aimed at broader knowledge of such concepts as an information-retrieval system's educational function, its utility for browsing, techniques for selective dissemination, ways to publish data on-line so that current information is really current and ways of selective updating, so that file space is not wasted on obsolete data.

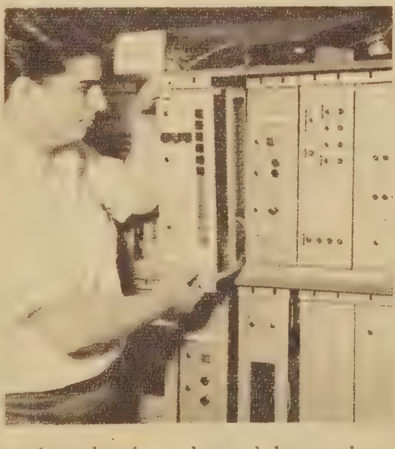
The Engineers' Joint Council has long-range plans of its own, in addition to complete computer preparation of the Engineering Index. To prevent its files being cluttered with obsolete data, it is working on techniques of critical evaluation and review by experts—presumably the same ones who initially review the input data. The feasibility of incorporating engineering data is also being studied; this data would back up the published reports of experimental work. Sources would be the laboratory reports from which technical papers are prepared.

There is little doubt that computers will eventually provide efficient and easy access to data. When that day comes, scientists and engineers will be better equipped to perform the more demanding tasks that await them.

("Electronics," Vol. 39, No. 5) ■

TRANSISTORISED MODULES FOR DATALOGGING SYSTEMS

The Centre for Computer Sciences and Technology of the National Bureau of Standards in the U.S.A., has developed a range of modules from which special purpose, automatic data recording equipment can be built up in a matter of days. Design and assembly of a data handling system is then a matter of simply breaking down the design to specific functions and using one of the modules to perform each function. A relatively small number of module types is sufficient to construct a large variety of special purpose data recording systems.



A rack of stock modules ready for use. By suitable interconnection, complete measuring and recording systems can be built up.

Assembly of a system consists, in the simplest case, of mounting the necessary modules in a rack, interconnecting them and wiring the system to the data source. Systems assembled this way at the NBS automatically obtain and record data from unattended experiments at rates up to 50 datum points a second. The systems can be programmed to vary experimental parameters, such as voltage or wavelength. Data obtained are usually recorded on a computer-compatible medium, such as magnetic or paper tape, so that they can be read without error directly into a computer for processing and interpretation.

The following modules are stock items at NBS: (1) programmable control module; (2) scanners and multiplexer modules; (3) analogue to digital converter; (4) paper tape reader modules; (5) event, or event-per-unit-time counter; (6) registers; (7) output modules.

Each module has its own power supply and requires only line power, signal inputs and programming of its functions. ■

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AC V: 10, 50, 250, 1000v (1k ohm v
DC A: 100mA.
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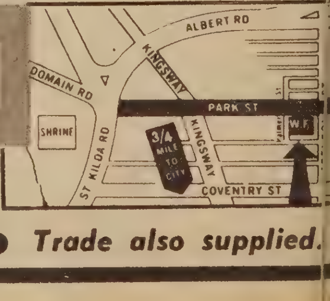

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DRIVERLESS TRAIN SYSTEM TESTED IN FRANCE

Experiments have been going on for some years in Paris, conducted by engineers of the public transport network, to develop an automatic driverless train system. This article, based on a report in the "French Technical Bulletin" (No. 5, 1966) outlines the progress made to date, and describes an experimental system already in use on some lines.

The automatic driver, now undergoing trials, controls the train so that t conforms to a standard running program and complies strictly with safety regulations.

Two operating conditions must be satisfied before a train can leave a station.

(1) The outgoing signal must indicate "track clear."

(2) The guard must close the doors and give the "start" signal. The button used to close the doors must be kept pushed in for about 30 yards beyond the station, as explained more fully later in the article.

The journey between stations is controlled automatically, complying with standard operating conditions, i.e., maximum operating speeds and decelerations dictated by gradients and curves. All signals are automatically obeyed, by slowing the train where necessary and bringing it to a halt before a red signal. When coming into a station, the train is slowed at an average deceleration of about 3.75ft per sec./per sec., and is brought to a stop with a positional accuracy of plus or minus 5ft, whether empty or filled to capacity.

The necessary signals to control drive to the driving bogie and braking are obtained by induction from conductor wires fixed between the track. The signals are picked up by detectors and fed to relays which control power to the driving bogie and braking. The conductor wires are fixed between the track rails in a "square wave" configuration. The pattern so formed is known as a "Greek border" because it was widely used by the Greeks in art and architecture.

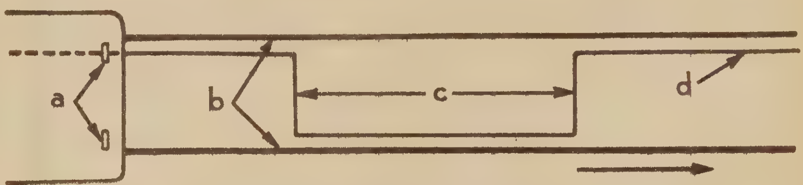

Figure 1. a — detectors mounted on driving bogy, b — rails, c — one step of Greek border, d — Greek border

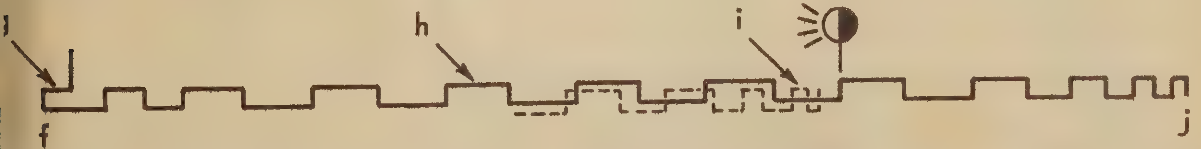

Figure 2. Arrangement of Greek border between two stations. f — station A; g — loop at station (to stop train); h — green border; i — red border; j — station B.

A 150Hz low voltage signal sends a 5A alternating current through the conductor wires of the Greek border. This 150Hz signal is picked up by magnetic induction by two detectors, mounted to left and right of the power bogie. The induced current is filtered and amplified, and fed to control relays. Supply to the Greek border (or borders, since in some situations more than one border is used, as explained later on in this article) is controlled by switchgear associated with track signals.

Each end of the train is equipped with its own system of detectors and relays, but it is always the system at the front of the train while it is in motion that has control.

The signals received from the detectors are amplified by a two-channel amplifier and then fed to the relay line, consisting of the initial relays, secondary control relays which directly control speed and braking, and auxiliary relays whose function is to ensure that all safety systems (e.g., door closing system) are operating and complying with the various operating regulations.

This system has several advantages. Firstly, any interruption of the current in the Greek border causes the train to come to a dead halt. Secondly, the speed of the train is under control at all times. This is accomplished by monitoring the time taken by the train to pass through one step of the Greek border.

The system can be more readily understood by referring to figure 1. This shows the Greek border (d) in position between the rails (b) and the detectors (a) mounted on the driving bogy. The distance between each step of the Greek border is indicated by (c)

It will be noticed that only one of the detectors can be receiving a signal at any instant as long as the train is travelling over a Greek border pattern.

It is the rate at which impulses from the Greek border are received by the detector/relay system which controls the driving bogie and brakes. It follows that two things can affect the rate at which pulses are received, i.e., the speed of the train or the size of steps in the Greek border. It also follows that if the steps of the Greek border are reduced in size, the train will cross more steps in a given time, and the brakes will be applied to restore the speed of the train to the standard operating condition. Conversely, by increasing the size of the steps, the train can be made to accelerate.

Standard operating conditions are therefore translated into step lengths of the Greek border, so that the length of the steps is proportional to the speed desired over the section of track concerned. The normal base time used is 0.5 second, and if a train is travelling at such a speed that it is passing steps at the rate of two per second, the brakes will remain off and there will be no traction applied, so that the train free wheels.

If the train takes longer than 0.5 second to pass successive steps, the relays controlling power to the driving relay engage, and traction is applied. Conversely, if the train passes steps at a faster rate than 0.5 second between steps, the relays controlling the brakes engage. Braking is engaged in five steps, and the faster the speed of the train above standard operating speed, the greater the amount of braking applied.

If the two detectors receive a signal simultaneously for longer than 15/100th of a second, the train is made to come to a halt.

The practical effect of this can be seen in figure 2, which illustrates the arrangement of conductor wires on the section of track approaching a signal. There are three Greek borders on this section of track, i.e., the "green border" for normal running conditions, a "red border" which comes into operation when the signal is set against the train, and a "yellow border" corresponding to the yellow signalling light (entrance allowed). To avoid confusion the yellow border is not shown.

When the train is required to stop at the unfavourable signal, the green border is replaced by the red border. The switchover is automatic when the signal is set to red. The diagram shows that

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Driverless Trains

Continued from previous page.

the steps in the Greek border become progressively smaller, so that the signals to the two detectors are of increasingly shorter duration. This has the effect of progressively reducing power to the driving bogie and increasing braking power. Just before the signal, the red border terminates, and no impulses are received by the detectors from this border; additionally, there is no current flow in the green border. Accordingly, the train is caused to stop.

If the light changes from red to green as the train is slowing down, the current is cut off from the red border and restored to the green border, and the train resumes normal running speed. However, if the train has had time to stop before the signal changes, it must be started again by the guard, by pushing the start button.

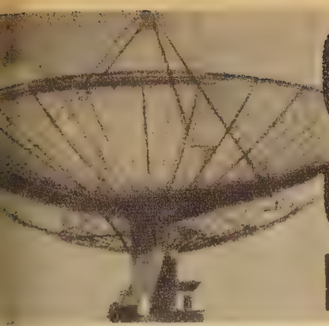
When the signal is set at yellow, the yellow border comes into operation, and this is arranged to slow the train to a speed of 15 m.p.h. and to allow it to proceed at this speed until normal conditions are restored.

At stations the conductor wire is not formed into the Greek border pattern but is formed into a loop, as shown in figure 2. This causes both detectors to be energised simultaneously, and as explained earlier, this causes the train to come to a stop. To start the train again, the guard must first push the start button, which operates the door closing mechanism and start relays on the driving bogie. Provided the signals are favourable, the train will then start.

The guard must then keep the button pushed until the train once again reaches the Greek border, some way out of the station. The lengths of the steps of the Greek border are gradually increased as the train pulls away from the station, so that the speed of the train increases until the standard operating speed is reached.

In case of need, the train can be manually driven. All that is needed to bring the automatic drive system into operation is to operate a switch in the driving cabin. A speed variator control is also provided in the driving cab, with steps calibrated in percentage above or below the standard operating condition. This variation is achieved by varying the time delay of the control relays so that the time base of 0.5 second is increased or decreased, according to the switch setting. The speed variator can be remotely controlled, so that the train speed can be varied to suit operating conditions.

Development of this driverless system was begun by engineers of the public transport network of Paris as long ago as 1951. Some years ago a test installation was set up on the Porte des Lilas — Pre Saint Gervais shuttle track. The results of this test installation proved that the system was practicable and safe, and the system has now been extended to the Chatelet — Marie des Lilas line. Further extensions are expected to follow as the idea gains public acceptance and the support of public transport employees. ■



SCIENTIFIC AND INDUSTRIAL NEWS

omputer without codes

“A London firm of consultants, John Hoskyns and Company Basinghall Street, has developed a system for giving instruction a computer without the use of codes,” reported Denis Desoutter the B.B.C. World Service. “It allows the operator to make his own abbreviations as he goes along, and leaves the mputer to sort them out.

“It gets over the usual business of looking up the code me for something else. When facts are wanted about, for ample, Teddy Bear Industries Incorporated, the operator can nply feed in any abbreviation that comes to mind. He might T Bear Ind, for example. The computer then rapidly mpares that abbreviation with all the full names on its register til it finds one that matches.

“With this system the operator does not have to remember e abbreviations he used last time, and hours of work in oking up code addresses are saved. The system obviously has de potential in other fields—in industrial storekeeping for ample, or in the stock-taking systems of supermarkets.”

lore National TV stations opened

Two more National television stations have been brought the air. On June 29, ABSN, Channel 8 was officially opened the Postmaster General, Mr Alan Hulme, to serve the Bega-ooma area of N.S.W. This station, with an effective radiated ower of 100KW vision and 20KW sound, is located on Brown ountain, about midway between Bega and Cooma. Programs e relayed by microwave link from the Sydney National ation, ABN, Channel 2.

The second station, ABSQ, Channel 1, serving the southern owns area of Queensland, was inaugurated by Mr Hulme, on ly 4. The station is located at Passchendale Ridge, about 10 iles north-west of Stanthorpe. It will serve about 40,000 ewers in the southern downs area, including Warwick, Stan-orpe, Tenterfield, Texas and Inglewood. Programs come from BQ, Channel 2 in Brisbane, also by microwave link.

The transmitter equipment for both stations was supplied Amalgamated Wireless (Australasia) Ltd. With the opening these two stations, there are now 29 National stations in eration from the total of 33 planned for country areas of ustralia.

ne touch tells

Firma M. Gatsonides, of Aerdenhout in the Netherlands, s come up with an interesting timer for swimming contests. omponents are an electronic timing meter, containing as many nchronous counters as tracks, and a number of bright red VC boards set up at the ends of the tracks, half under and alf above water. Behind each of these touch boards runs a lastic air hose combined with an air switch which reacts to pressure of only 40 grams.

As soon as a board is touched, an electrical impulse is mitted from the position and stops the counter of the time ock which is graduated in fiftieths or hundredths of a second.

All the equipment is easy to instal or remove and, if equired, it can be made to operate with a print-out device hich gives individual times on a strip of paper, identified with nannel numbers. The timer will continue to run until all ontestants have finished the race and, since the swimmer is esponsible for the action which determines the time, there is ss likelihood of mistakes than with stop watches. The counters re accurate to one second in 80 hours.

asers speed car production

A Japanese company claims it has developed a means to halve ne two years needed to put a new car into production, with a ew application of the laser beam.

Hitachi Ltd. said the technique was to run the laser beam ver the designer's full-size clay model and then feed the data nto a computer. A numerical control-type milling machine linked o the computer would then turn out parts for easy assembly.

Industrial stethoscope is transistorised

A stethoscope with a transistorised amplifier, for industrial use, is now available in Australia. Called the “Minearscope,” it is marketed by Mindrill Ltd., of Preston, Victoria.

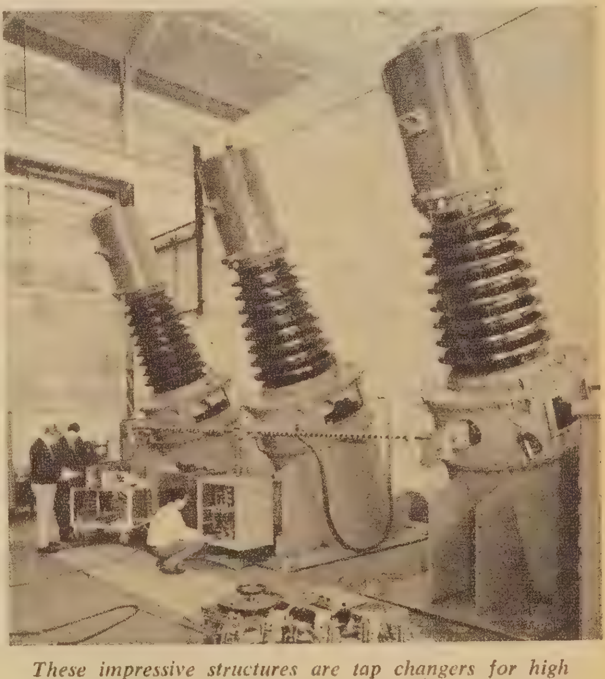
Applications include maintenance and inspection of engines, motors and machinery, or any situation where noise detection is of significance. The self-contained unit uses a long-life mercury battery, and is claimed to be sensitive enough to detect irregularities in the flow of liquids. A combined on-off switch with thumb-operated control activates the probe, which is simply touched lightly on the part under examination; only one hand is needed while using the instrument.

Classroom television aid

A new educational television unit designed especially for classroom use has been developed in Britain by Pye T.V.T. Ltd., Cambridge. Named the “Teletutor,” it will show high-quality pictures from any internal or external source and can be used in small classrooms or large lecture halls.

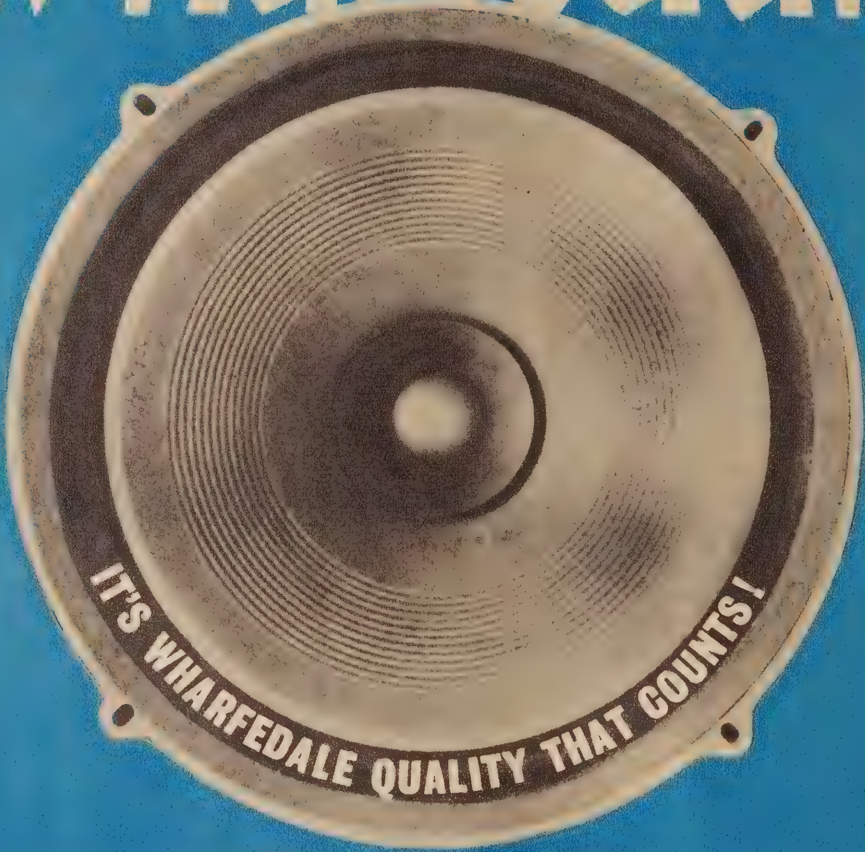
The unit is basically a receiver with a 25in screen. It is fully transistorised and is robustly built to withstand rough handling in the classroom. All controls can be locked away behind a hinged metal cover, and the case is finished in scratch resistant paint.

It is designed to receive broadcast programs from Britain's educational TV service, special programs sent out to selected colleges and schools by microwave transmitters and to work as part of a closed-circuit system.



These impressive structures are tap changers for high voltage transformers, standing ready for testing at the Manchester (U.K.) works of Associated Electrical Industries Ltd. They enable the voltage tapping positions of 132/400KV transformers to be changed while on load, and are designed for mounting on the top rather than the more conventional position at the side of the transformer, thus reducing the transformer's width and reducing enclosure costs.

Wharfedale



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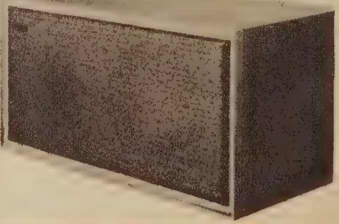
What's in a name? For over thirty years WHARFEDALE speakers and speaker systems have been advanced in design . . . the finest sound reproducers in every class proudly carry the WHARFEDALE name. The WHARFEDALE range is extremely wide; in every category or price, quality or size, **WHARFEDALE sound is superior.**

WHARFEDALE's exclusive roll surround permits extended cone excursion in small or airtight enclosures to provide most effective bass response; high frequencies retain linearity due to the use of WHARFEDALE's unique double diaphragm. Transient performance of WHARFEDALE loudspeakers and speaker systems is remarkable — clarity and attack are particularly obvious in all wide-range WHARFEDALE units. **Ask for a free catalogue describing the complete WHARFEDALE range at your favourite audio store.**

The new WHARFEDALE "Linton" measures only 19" x 10" x 10" and offers high fidelity sound reproduction with substantially linear bass response, extended H.F. performance and high sensitivity. Two completely new WHARFEDALE speakers are featured in the "Linton" — an 8" bass unit and a tweeter developed from the famous WHARFEDALE "Super 3". An entirely new surround, WHARFEDALE Flexipr reduces the basic resonance of the woofer only 43 c/s. Overall frequency range of "Linton" is 40-20,000 c/s., power hand capacity 10 watts R.M.S. and impedance or 15 oh



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Tel. 92 3890

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OVER 90% OF AUSTRALIAN RADIO AND TELEVISION STATIONS, AND RECORDING STUDIOS HAVE STANDARDISED ON

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n broadcasting and television studios vhere facilities are available for precise neasurement, audio engineers specify RTOFON moving coil pick-ups. Recordng studios demand stable, distortionree pick-ups . . . and select ORTOFON! Vhy is this so? The ORTOFON moving oil system is inherently more linear — RTOFON cartridges are completely reiable, predictable and consistent. Only RTOFON is free from the problems of ion-linear hysteresis and transient breakip common to most variable reluctance, noving iron and moving magnet-type nagnetic cartridges. ORTOFON output s higher, too, when used with the natching ORTOFON transformer. Hum roblems are thereby eliminated.

Stereo reproduction is more demanding han ever before . . . even minute disortion makes an otherwise perfect ystem sound second-rate. The audio nthusiast seeking the ultimate in high idelity reproduction can purchase ORTOFON arms and cartridges with comlete confidence. **The most realistic high idelity sound originates with ORTOFON.** The new ORTOFON SPU series has been ndorsed by leading critics all over the vorld.

We invite you to hear ORTOFON today at your favourite audio store . . . compare ORTOFON pick-ups with any others regardless of price . . . and listen to the astounding difference!

The ORTOFON elliptical diamond stylus in the SPU - GT - E cartridge closely approximates the shape of the original cutting stylus, and will track the most complex wave form without distortion due to pinch effect. Freedom from distortion is obvious towards the centre of a disc where pinch effect is always a problem. Tracking pressure of 2 grams and less minimises stylus and record wear.

Illustrated is the SMG 212 tone arm and the SPU-GT-E cartridge. ORTOFON tone arms are available in 9 models. Type "A" cartridges are for general hi-fi use . . . type "C" for professional users and the serious music lover. The SPU series has been designed for all high-quality stereophonic applications. Any cartridge may be used with ORTOFON "G" arms when fitted with the open-front metal "G" shell.

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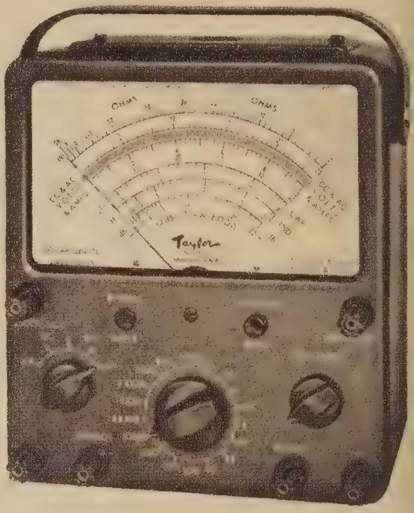
Taylor METERS

88B MULTIMETER
PRICE $90.80

Plus Tax at 12½ per cent for Sydney
Slightly Higher Interstate



68 RANGES—OVERLOAD CUT-OUT
0-10 AMPS 0-2500V AC & DC.

This is a very robust multimeter which will measure both AC and DC voltage and current, db, output, capacity and inductance, also resistance, to 50 megs. The 88B is fitted with a resettable overload cut-out, also a reverse polarity facility. The Taylor centre pole meter has an anti-parallax scale which is calibrated in three colours.

A high-quality leather case (optional extra) is available for protection during transport.

SPECIFICATIONS

Sensitivity	DC: 20,000 opv; AC: 2,000 opv.
Accuracy	DC: 2 per cent. AC: 3 per cent.
Volts	DC: 0-2500 (13 ranges), 25KV with probe (extra). AC: 0-2500 (11 ranges).
Current	DC: 0-1000mA (13 ranges). AC: 1-1000mA (9 ranges), AC and DC: 0-10A.
Resistance	1 ohm-50 megs. (5 ranges).
Output	As in AC ranges.
Capacity	1000pF-100uF (4 ranges).
Inductance	0.2-20H (2 ranges).
DB	—10 to +68 (9 ranges), 0=1mW in 600 ohms).

MODEL 101
PRICE $64.00
Plus Tax at 12½ per cent
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Slightly higher Interstate

MODEL 101

Sensitivity	DC: 100,000 opv AC: 5,000 opv
Accuracy	DC: 2%: AC: 3%
Volts	DC:0—1,000 (7 ranges) 25KV with probe (extra) AC: 0—1,000 (5ranges)
Current	DC: 0—250uA (3 ranges) 0—1000mA (2 ranges) 0—10 amps (2 ranges)
Ohms	0—200 megs (4 ranges)
Db	—10 to +62db (5 ranges)
Output	0—1000V (5 ranges)
Scale	5" anti-parallax 3 colour
Extras	Leather carrying case
Size: Weight	8¼" x 7½" x 4½ — 4¼lbs

MODEL 127A

Sensitivity	DC—20,000 opv. AC—1,000 opv.
Accuracy	DC:—3% FSD: AC—4% FSD
Volts	DC:0—1,000 (7 ranges) 25KV with probe (extra) AC:0—1,000 (5 ranges)
DC Current	50/uA—100/mA (4 ranges) Shunts to 10A available
Resistance	0—20 megs (3 ranges)
DB	—10 to + 62 db (5 ranges)
Weight: Size	1 lb: 5¾" x 3¾" x 1¾"

MODEL 127A
Price $31.50
Plus Tax at 12½ per cent
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IENTIFIC NEWS — cont.

ppler for BOAC 707's

In U.K., the British Overseas Airways Corporation (BOAC) placed an order with the Marconi Company for Doppler vigation systems for their fleet of Boeing 707 aircraft. All exist- aircraft of the BOAC jet fleet are already fitted with Marconi pple.:.

The Marconi Company claims its Doppler system is one of most accurate forms of long-distance navigational aids avail- le. It is entirely independent of ground-based aids, and is par- larly valuable to BOAC, whose route structure includes the rth Atlantic, Pacific and Indian Oceans, as well as large parts Africa and Asia, where ground aids cannot be provided at sent.

Proving trials in BOAC Super VC-10s have shown that actual sition errors after a trans-Atlantic crossing of some 18,000 utical miles vary between three and 10 nautical miles—well low one per cent.

ast displays show U.K. election results

Viewers in Britain, watching General Election figures on their evision screens, saw in action one of the fastest data displays the world. The Marconi tabular display, which can "write" up 50,000 letters or figures a second, flashed key results, almost stantaneously, onto television screens.

This display, designed as a fast-writing source for computer ntrolled defence radar systems, was soon found to be ideally ited for a wide variety of applications. On election night the splays were fed from punched paper tape and viewers could see e more important results coming in by telephone and teleprinter om all parts of the U.K. Tapes were prepared in advance, on a arconi computer, to cover every possible result in more than 150 y constituencies.

The displays look rather like small television receivers. The tters and figures are written on the tube face by an electron am in a similar manner to an oscilloscope waveform rather than the conventional television scanning method. Marconi television meras were permanently trained on each of the three tabular splays providing pictures suitable for direct transmission.

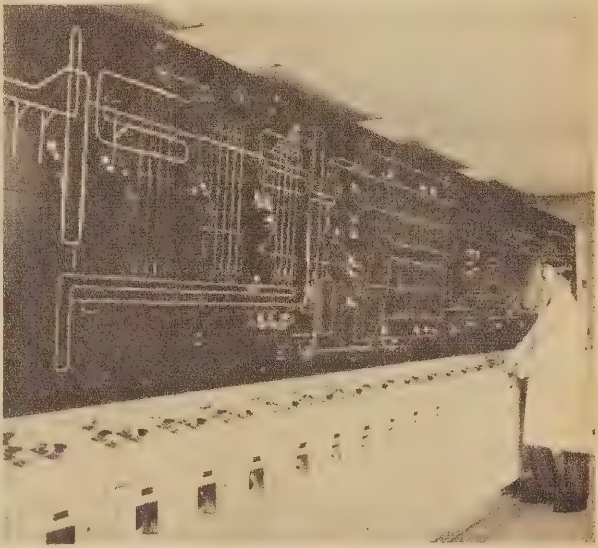
Automatic record players undergo rigid inspection and performance tests at the Garrard Engineering Ltd. works at Swindon, Wiltshire, England. Garrard Engineering was one of 115 companies named recently as the first winners of the Queen's Award to Industry. The award is to be made annually in recognition of outstanding achievement in increasing export or in technological innovation.

SEACOM cable extension

Work has begun on laying the Madang-Cairns section of the South-East Asia Commonwealth submarine telephone cable — SEACOM. About 770 nautical miles of coaxial cable, with 52 repeaters at intervals of about 17 miles, will be laid by HMTS Monarch, assisted by CS Retriever. Another 740 nautical miles of cable required to complete the link will be laid later this year by CS Mercury.

Work on testing and adjusting the equipment necessary to derive the telephone, telegraph and other circuits will begin as soon as the submarine sections are completed, and is expected to be finished by April, 1967. Cable stations for the SEACOM project at Guam, Madang and Cairns have been constructed and will be operated by the Overseas Telecommunications Commission (Australia).

The Cairns end of the SEACOM cable will be connected to the COMPAC cable at Sydney by means of a combination of microwave link and coaxial cable systems.



This console records and regulates over three miles of overhead conveyors at the new $50 million engine plant of the Ford Motor Company in U.K., located at Dagenham, Essex. Long sequences of operations are now fully automated, and engine parts travel automatically from one group of machines to another. The system includes waist-high workbenches suspended from the conveyors on hanger arms, so that engines can be assembled while moving along the worklines. Every hanger can be preset to direct the engine to its proper location, and a simple control can direct an engine out of the flowline for special attention.

S.T.C. telephones used in Vietnam

Australian troops in Vietnam are using a portable telephone manufactured by Standard Telephones and Cables Pty. Ltd., of Liverpool, N.S.W., for communication in difficult terrain.

The "K" phone, as it is called, can be used as either field or office telephone, operating from either its own internal 3V battery or from a central or common battery. It weighs only 4lb 2oz, and can be operated with one hand. For security reasons, the ringing tone can be adjusted from "loud" to "quiet," or may be silenced completely, by means of a simple adjustment which can be operated by the edge of a coin or identity tag.

The telephone may be used on magneto, central battery signalling and common battery circuits, and in radio link circuits. Two dry cells are housed in each set to provide a local battery for the speech circuit, except in common battery and central battery signalling systems. A spring-loaded switch is operated during the "send" condition only. This switch also functions as a "send/receiver" switch when the "K" phone is used on radio link circuits.

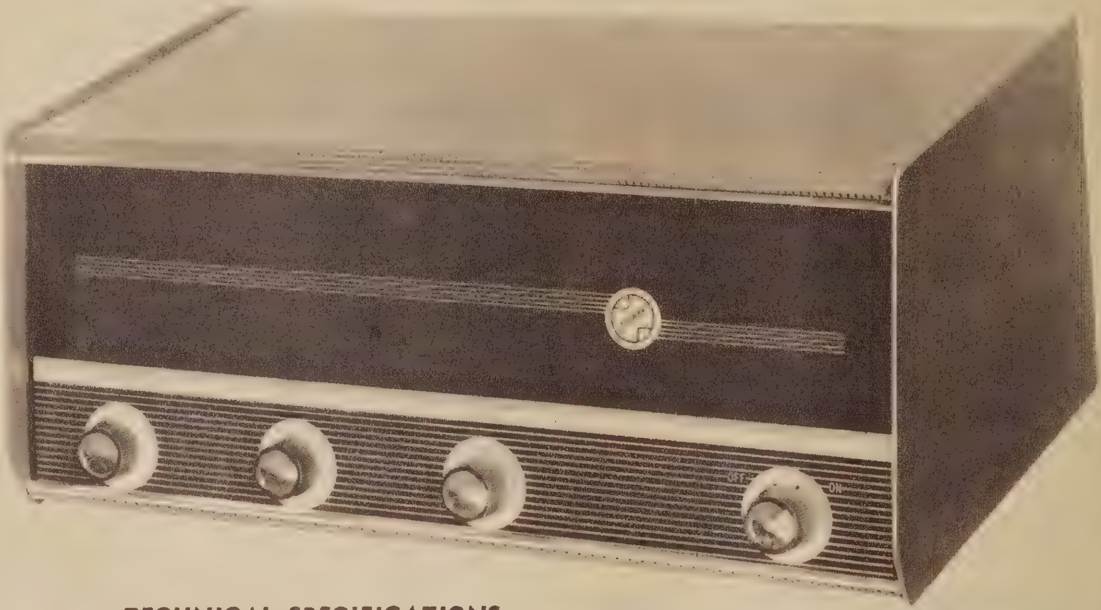
The electronic components and battery are contained in a small unbreakable nylon case sealed against humidity, water, dust and mud. A handset can be connected to jacks on either side of the case, thus allowing the handset to be connected from either right or left, or two handsets to be used simultaneously. The unit has an effective range of 10 miles.

The manufacturers visualise the unit will have many applications outside military use, to serve communications need in industry, commerce and agriculture. Its ruggedness makes it suitable for use on construction sites, in tunnels and excavations and for civil authorities dealing with civil emergencies.

Public Address Amplifiers

Models PA 35 and PA 65

These amplifiers are intended to cover a large range of requirements where reinforcement of speech and/or music is required. They are eminently suitable for installation in clubs, conference rooms, restaurants, hotels, etc.



TECHNICAL SPECIFICATIONS

	PA 35	PA 65
Nominal power	35 watts	65 watts
Peak power	40 watts	70 watts
Microphone sens.	3MV (100K ohms)	As PA 35
Pickup sens	125MV (1 megohm)	"
Tone control	Minus 20DB at 10KC	"
Response	30-17,000 CPS + 3DB	"
Noise	Minus 60 DB	"
Inputs	1 microphone/ 1 pickup	"
Provision for	50 ohm Input	"
Output impedance	100V Line (330 ohms)	"
Regulation	3 DB	"
Valves	Two 12Ax7 Two 6DQ6B	"
Rectifier	5 x IN3194 Silicon Diodes	" As PA35
Fuse	2 amp.	2 amp.
Dimensions	16" x 9½" x 6½"	As PA 35
Gross Weight	21 lb.	21 lb.

PA 35 $117.25
£58/12/6

PA 65 $138.60
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Price Retail Plus Sales Tax

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N.Z.: P. H, Rothchild, 83 Pretoria St., LOWER HUTT.

TV monitoring of aircraft performances

Continuous real-time visual monitoring of high performance aircraft will soon be possible for the first time with a closed circuit television and distribution system now being built in the United States by Litton Industries.

Called "Flitevision," the system will be installed by Litton for the U.S. Air Force at Edwards Air Force Base, California. It will collect, transmit, process, record and distribute visual flight test data.

The equipment will be at 16 fixed locations in two mobile vans, two C-130 aircraft and in eight supersonic chase and data aircraft.

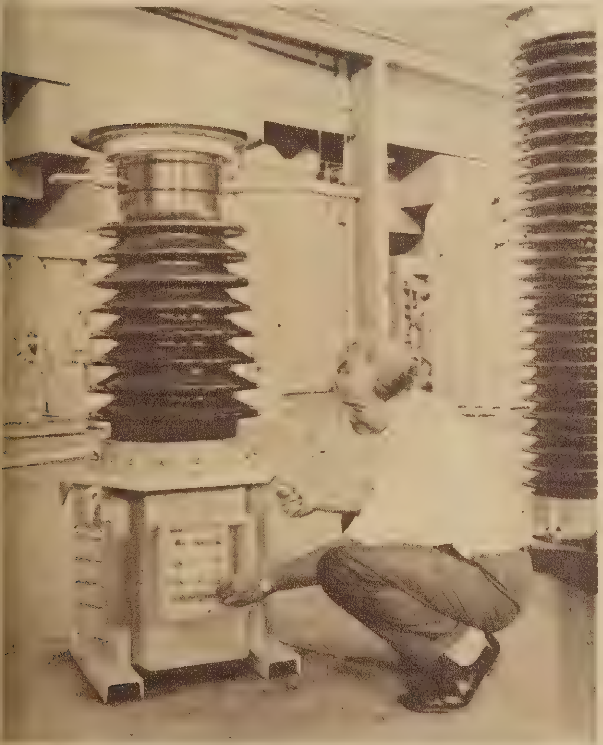
About 87 television cameras and monitors will be connected by cable and microwave links in the system. Television cameras on the ground and in the chase aircraft will follow each test flight and transmit pictures to the base centralised test mission control and monitor display complex. Videotape recording equipment will give extra flexibility to the system by recording data for reference and later evaluation.

Initially, the Flitevision equipment will supply black-and-white observation of test flights of the XB-70, X-15, YF11A and F-111 test flights—all super-performance aircraft.

Automatic Telex opens

At 5.30 p.m. on Monday June 27, 1966, at the Sydney G.P.O. the Postmaster General, The Honourable Alan S. Hulme, M.P., officially opened Australia's automatic Telex network.

The Telex service provides subscribers with a teleprinter service between their machine and the machine of any other subscriber within the Australia-wide network. The teleprinter offers a number of advantages in many applications, among these being that a printed record of messages sent and received is provided at both ends, and that messages may be transmitted at any time, whether the other subscriber's premises are occupied or not. And, with the advent of the automatic system, charges are based on the time taken to transmit the message, rather than on three-minute segments.



Pictured is one of a new type of current transformer being supplied by the Ducon Power Equipment Division of the Plessey Components Group to power authorities in N.S.W. and Queensland. The transformers use a completely oil-filled high volume bellows located inside the circular cap at the top. This "O.F." insulation technique is said to reduce the amount of maintenance required and to considerably extend the life of the equipment. Current transformers are used for the measurement of current flowing through a supply system as well as for the protection of associated equipment in the event of current exceeding the safe limit.

After the official inauguration of the automatic Telex system, Postmaster-General A. S. Hulme listens attentively while a Telex operator explains the operation of her machine. Also in the picture are (left to right) Mr T. A. Housley, Director-General of the Overseas Telecommunications Commission (Australia), Mr Davis Hughes, Minister for Public Works, and Mr J. N. Cope, M.P. (See story this page.)

There are 2,400 Australian Telex subscribers in the system at the present time, and each subscriber may now call any other subscriber directly, without the intervention of a human operator. In addition, Australian subscribers may contact over 80 overseas countries—19 of them through the automatic service.

Establishing contact with another Telex subscriber takes only a few seconds. The operator operates a "call" button on the teleprinter and waits for a "GA" (Go Ahead) signal to appear. When it does, the operator calls the wanted subscriber by depressing the appropriate keys. Assuming that a circuit is available, the called subscriber's answer back code will be received, to enable the calling operator to confirm that contact has been made with the correct subscriber. Assuming that it is correct, the calling operator then identifies himself and proceeds to type the message.

If the answer back code is incorrect, the calling operator is given approximately five seconds to recognise this and operate a "clear" button which will take down the connection before any charge has been recorded.

Messages may also be prepared on punched tape, by means of a separate machine, thus enabling a number of messages to be prepared in advance of establishing a connection, and ensuring that the messages are transmitted as smoothly and rapidly as possible once the connection is established. This can result in a significant saving in cost on long circuits.

The Telex automatic system uses standard cross-bar automatic telephone exchanges. Simple DC circuits are used between the subscriber and the local exchange, and for purely local calls. Where trunk circuits are involved carrier circuits are employed, with the Telex service occupying a standard 50 baud telegraph channel derived by dividing a single telephone channel into several narrow band circuits.

All the Telex equipment is supplied and maintained by the P.M.G.'s Department on a rental basis. Call charges range from 90 seconds for 5 cents for distances not exceeding 100 miles, to 12 seconds for 5 cents for distances exceeding 400 miles. Charges are slightly cheaper at night.

Among today's users of the Telex system are newspapers, airlines, and various business organisations, many of whom maintain continuous circuits between capital cities within Australia, or with overseas capitals. While the annual cost of such services is high, the convenience and savings it makes possible fully justifies this.

A.W.A. mobile radio for Papua and N.G.

The Papua and New Guinea Administration has ordered mobile radio equipment from Amalgamated Wireless (A'sia) Ltd. for the establishment of a radio-telephone network in the territory. The initial order is for a control station, a talk-through repeating base station and 43 mobile units which will be installed in departmental vehicles used by staff members.

The Administration has also placed an order with A.W.A. on behalf of the Department of Forests for equipment which

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can supply
any picture tube —
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Thomas Electronics are picture tube specialists. They make picture tubes — *only* picture tubes.
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And they give the fastest delivery service.

- Both Premier Picture Tubes and New Replacement Tubes are warranted against all manufacturing defects for 12 months.
- Daily Delivery to country areas by passenger train or road transport.
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Country Servicemen Please Not
You may phone your orders to Thomas Electronics and reverse the charges. And we will pay the fir 10/- of freight charges.
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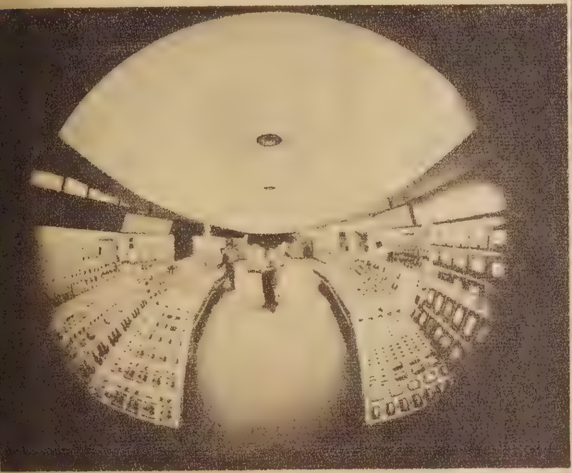
ll be used to establish a communications system in the Bulolo alley. The New Guinea Electricity Commission, which already es A.W.A. mobile radio equipment, has also placed an order r an additional 12 mobiles to extend their Port Moresby stem.

astors absorb shocks

Castors which absorb shocks without using springs have been eveloped by the United States Atomic Energy Commission and ay be made under royalty-free licences. Details are available om the Patents Counsel, Atomic Energy Commission, Washing-n, D.C. 20545.

Wheels of unusual construction account for the shock-osorbing capacity. Rubber tyres are held between flanges whose ub rolls on the shaft, but the tyres do not contact the hubs. nstead a cavity is left into which the rubber tyres can deform hen subjected to shock loads.



This unusual view of the control room of Britain's new 1,400 megawatt power station at Tilbury, Essex, was taken with a "fish-eye" lens camera. This automatic control system for four 350 megawatt generating sets has been designed, engineered and installed by Elliot-Automation Ltd., London, for the Central Electricity Generating Board.

)uieter pneumatic tools

A two-stage silencer of special design has been fitted to British diesel-powered air compressor, so that it meets the commendations of the Wilson Committee on noise, and is erefore suitable for use in built-up areas. A mobile unit, it ill operate two large or three medium-sized pneumatic tools, ıd is designed for use by contractors, local authorities and ıblic services.

The silencer has glass-fibre baffles at each end which can removed in a few seconds for maintenance; it is only 3.5in nger than the conventional silencer it replaces. A second ntribution to quietness is made by operating the engine at optimum "silent running" speed of about 1,600rpm, when a aranteed free-air delivery of 125 cu. ft./min. at 100psi is tained. Even at 2,000rpm, delivering 150 cu. ft./min., the ise level is well below conventional units.

The compressor is powered by a Ford diesel, via direct itchless drive; an automatic control regulates engine speed to demand. Made by the Hymatic Engineering Co. Ltd., Aus-lian agent is H. P. Gregory and Co. Ltd., 74 Clarence Street, dney.

atty additives for concrete

Three fatty acids added to concrete may improve its aracteristics, reports the Fats and Proteins Research Foundation Des Plaines, Illinois. They are 9-carboxystearic acid, oleic and lorohydrin, and the maleic anhydride of oleic acid.

Their use is said to improve the water-proofing characteristics the concrete when cured. They also entrain more air, needed improve workability and durability, than the cheap soaps often d for this purpose. They do not delay setting nor decrease mpressive strength, the Foundation says.

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Logic and counting circuits — 4

COUNTING with the "FLIP-FLOP"

A bi-stable element from two NOR gates—the simple R-S flip-flop—the gated R-S flip-flop—the J-K flip-flop — "ripple-carry" counting — forward, reverse, and bi-directional counting.

by Jamieson Rowe

In the preceding article in this series, it may be recalled, we discussed numerical notation and encoding systems and looked at the type of counting circuitry which does not employ circuit elements of a bi-stable nature. Let us now turn our attention to the type of counting circuitry which nowadays is the more common: that which **does** employ bi-stable circuit elements. An appropriate place to commence our discussion is an examination of the bi-stable circuit elements themselves.

As the name suggests, "bi-stable" circuit elements are circuit sub-sections which have two (or alternative) stable operating states. External conditions may be used to switch the element from one of these states to the other, and back again as desired; but between changes in the external conditions the element retains the operating conditions which resulted from the last switch-over — in short, it has "memory" or **storage.**

Quite a few devices and circuit configurations have two stable states. The tunnel diode may be operated in this fashion, as may neon bulbs and PNPN diodes. Similarly, devices like toroidal ferrite cores may be arranged to be stably magnetised in either direction. But probably the most common bi-stable element is the valve or transistor **"flip-flop,"** also referred to as the "bi-stable," "multi" or "binary."

The flip-flop may be considered to be equivalent to two interconnected NOR gates. Figure 1 shows the idea; the output of each NOR gate is connected to one input of the other gate.

A moment's consideration of this diagram should show that only one NOR gate can be "on" at any particular time, where being "on" is taken to imply the presence of a logical "1" at the output. (If the positive logical polarity is adopted, 1=+9V, 0=0V, etc.). When gate A produces a 1 at M, this provides gate B with a 1 input, forcing it to produce a 0 at N; similarly, if B produces a 1 at N, this forces A to produce a 0 at M.

Whichever gate produces a 1 at its output forces the other to produce a 0; conversely, the gate which produces maintains the other in producing The arrangement is quite symmetri so that both possible states are stabl

To switch the circuit from one s to the other it is simply necessary apply a 1 pulse to another input whichever gate is currently producin 1 output. Thus, if gate A happens to on, application of a 1 pulse to leac will force it to turn off—producin 0 at M and thus allowing gate B to t on. This will, in turn, produce a 1 N. maintaining the new state of aff after the external input pulse at X cea Similarly, the circuit may be switc back again by application of anothe pulse to lead Y.

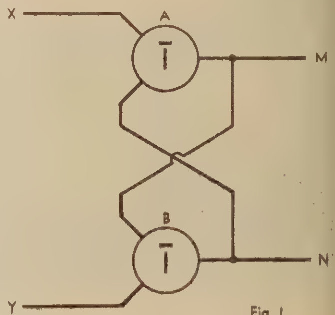


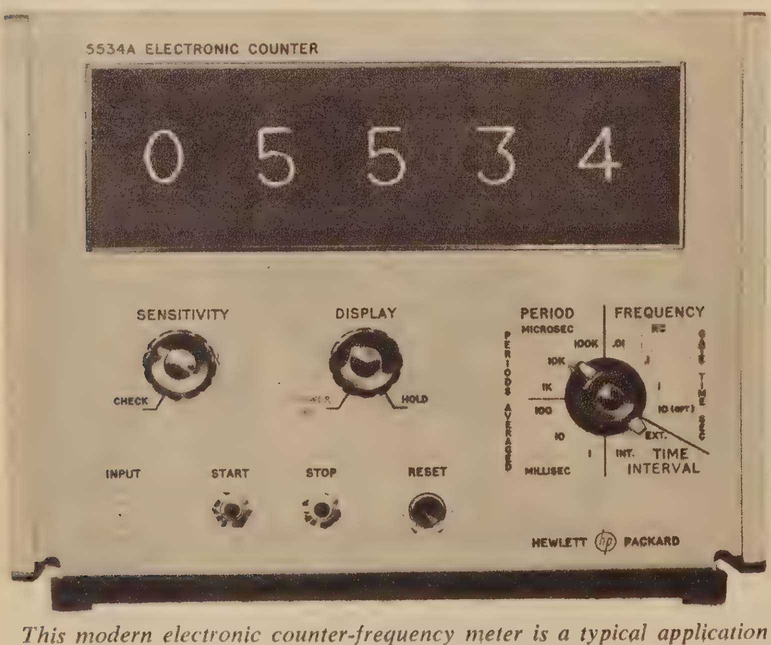
Fig. 1

Readers who constructed the N gate panel described in the second art can demonstrate the above opera for themselves quite easily by connec two of their gates as in figure 1. these gates use positive logic, applica of +9V (=1) to a spare input of "on" gate will be seen to produce swi over.

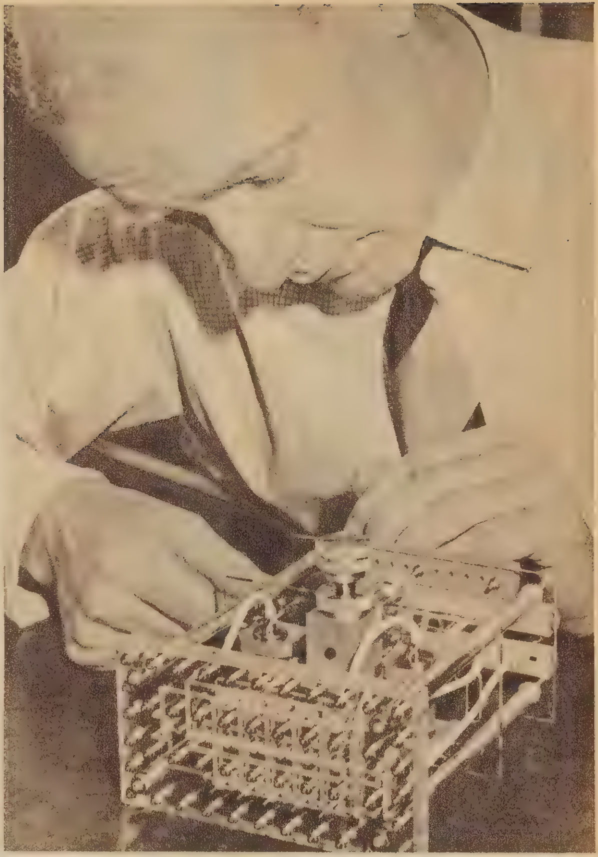
The arrangement shown in figur represents the simplest type of flip- element, often called the "reset-set" **"R-S flip-flop."** This type of flip-flo used mainly for storage of binary formation; having two possible st it can store one binary digit or **bit** representing "zero" by one state "one" by the other.

The circuit for a simple transi R-S flip-flop is shown in figure 2, gether with its usual logic symbol. may be seen, the circuit is virtually of two interconnected NOR gates the resistor-transistor or "RTL" vari The lead coding indicates that a log 1 applied to a "set" (S) input tend produce a logical 1 at output Y, wh as a 1 applied to a "reset" (R) in tends to produce a 0 at Y and a 1 the complementary output.

Note that both DC level and pulse puts may be provided, but that logical convention used for pulse in is negative rather than positive a used for both input and output levels. This is because with NPN t sistors pulse input signals are made



This modern electronic counter-frequency meter is a typical application of the bi-stable counting elements discussed in the article. A later article in the series discusses such instruments in more detail. (Photo courtesy Sample Electronics Pty. Ltd.)



Electronic circuitry is by no means the only medium available to the designer of logic and counting equipment. This new data processing system uses streams of compressed air. (Courtesy British Tele-communications Research Ltd.)

ative-going. The reason for this is that with pulse input signals it is generally easier to initiate switch-over of the flip-flop by applying a "turn-off" pulse to the conducting transistor than by applying a "turn-on" pulse to the non-conducting transistor.

As may be seen, logically equivalent pulse and DC level inputs are applied to opposite transistor bases. Thus to "set" the flip-flop (i.e., to produce Y=1), the DC level S signal is a +9V step applied o the left-hand transistor; but a −9V pulse applied to the right-hand transistor via the alternative S input will produce the same effect.

If a circuit of the type shown in figure 2 is required to operate at high speeds, t is common practice to fit suitably selected small capacitors in parallel with the cross-coupling resistors as indicated. Such "speedup" or "commutating" capacitors maintain the flip-flop loop gain at high frequencies by compensating for the transistor input capacitance, and alow the circuit to switch over rapidly.

The R-S flip-flop is not particularly suitable for counting purposes because its "input" virtually alternates between the R and S leads every time the circuit switches over. In order to change the state one must know its existing state, because application of the input 1 (either DC level or pulse) to the inappropriate input will have no effect.

It is not feasible to apply the input to both leads simultaneously in the hope that the flip-flop will simply "ignore" the inappropriate signal, because this has a quite indeterminate outcome. A "race" condition is produced by interaction between the input signals and the internal switching action.

The above behaviour can be defined conveniently and economically by a "truth table" of the same type which we used to define the operation ol logic circuitry. Thus if the subscript "n" is used to indicate the values of the flip-flop outputs prior to the application of the inputs R and/or S (either DC or pulse) and the subscript "n+1" to indicate values afterwards, the following truth table applies to the R-S flip-flop:

S	R	Y_n	$\overline{Y}_n$	Y_{n+1}	$\overline{Y}_{n+1}$
0	0	1	0	1 } Y_n	0 } $\overline{Y}_n$
0	0	0	1	0	1
1	0	1	0	1	0
1	0	0	1	1	0
0	1	1	0	0	1
0	1	0	1	0	1
1	1	1	0	?	?
1	1	0	1	?	?

For counting and many other purposes t is necessary to extend the basic R-S flip-flop by providing it with gating circuitry whereby the input (pulse) signals are guided to the appropriate input lead by control signals derived either from within the flip-flop itself or from external circuitry. A flip-flop provided with such gating circuitry is often called a **"gated R-S flip-flop."**

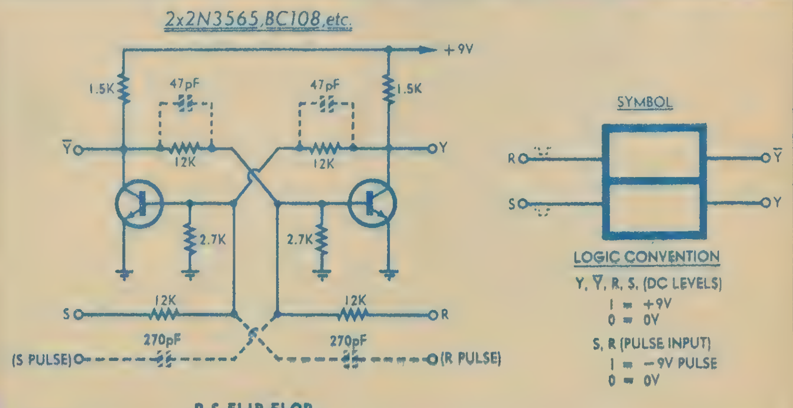


Fig. 2 **R-S FLIP-FLOP**

There are many ways of performing the input gating or "steering" function necessary to produce gated R-S flip-flop action. However the easiest to follow is probably that wherein the input pulses are guided to the appropriate transistor base by simple diode AND gates of the type shown in figure 3.

Here the input pulses, which are negative-going, are routed to each transistor base via a series capacitor and diode network. A resistor is connected to the junction of each capacitor and diode, and by applying DC gating signals to the resistors it is possible to "open" one of the gates and "close" the other — guiding the input pulse to the appropriate transistor. The logic polarity of the gating signals is **negative** (i.e., 1=0V, 0= +9V), because a positive control signal applied to a resistor will reverse-bias the diode concerned and thus "close" the gate.

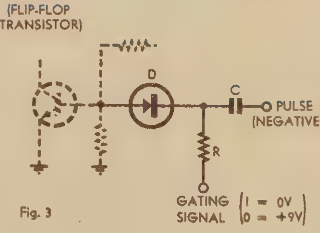
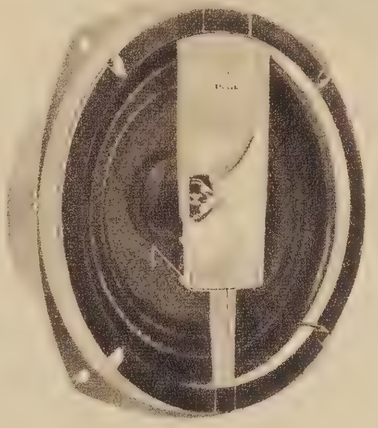


Fig. 3

Figure 4 shows how two such AND gates may be added to the basic circuit of figure 2 to produce a gated R-S flip-flop. The single pulse or "toggle"

PEAK



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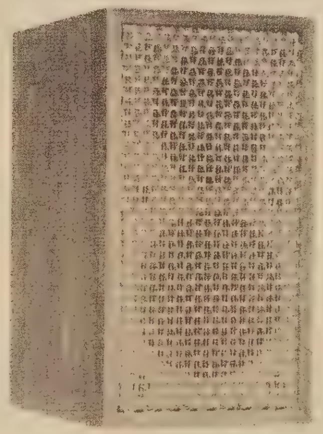

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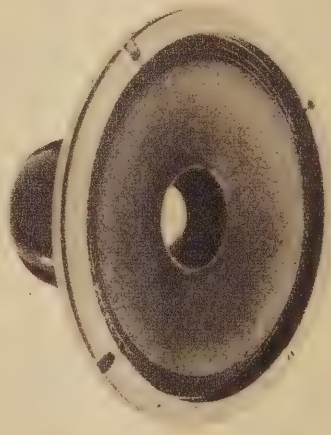

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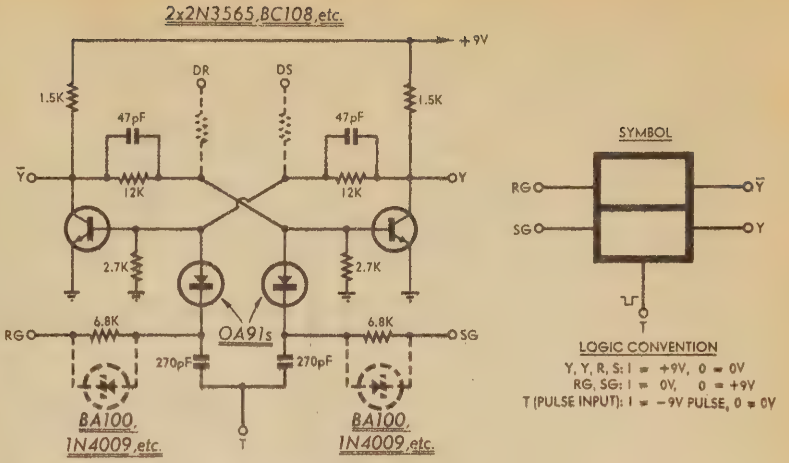
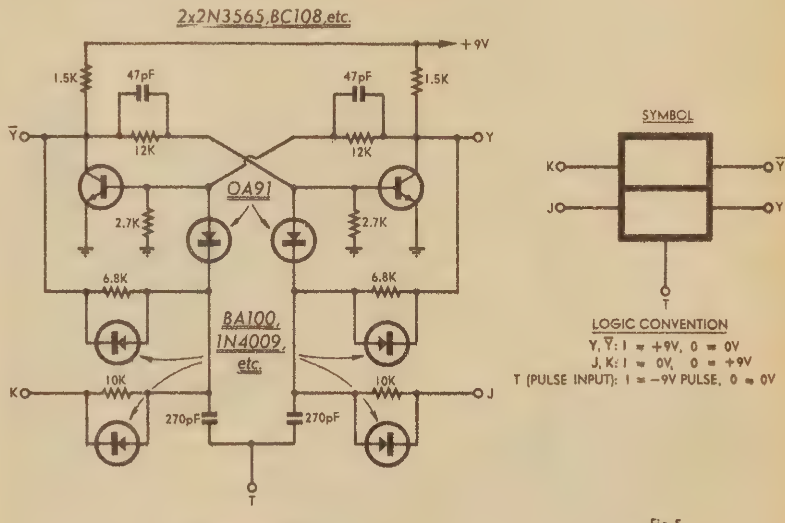


GATED R-S FLIP-FLOP

Fig. 4

Above and below are simple transistor circuits showing two common developments from the basic R-S flip-flop.



J-K FLIP-FLOP

Fig. 5

.put is labelled T, while the connections , the gating resistors are labelled "RG" eset gate) and "SG" (set gate) reectively to indicate that in each case control signal 1 (=0V) will cause the egative-going input pulse to be guided the transistor base appropriate to roduce either the reset (Y=0) or set (=1) state. The figure also shows e usual logic symbol for this type of p-flop.

As the diagram suggests the gated R-S p-flop may be provided with "direct" eset (DR) and set (DS) inputs in addion to the gated pulse input. These may e used both for "clearing" a counter f its registration and also for arranging r "filling" where a counter is arrangd to count in a BCD code. Both these ses will be discussed in the following rticle.

As before, operation is speeded up by eans of commutating capacitors across e cross-coupling resistors. With the ircuit of figure 4 it also proves desirable fit additional diodes across the gating esistor, as shown. The diodes allow the 70pF input capacitors to discharge uickly at the cessation of input pulses.

By virtue of its single pulse input and ating facilities, the gated R-S flip-flop as a great many uses in counting, logic, ithmetic and storage applications. owever for some purposes it still has shortcoming inherited from the simple S flip-flop. This is that the "indeterinate output" condition can still occur ever the two gating signals are both logical 1 (=OV) at the same time— lowing the input pulse to be fed to oth transistor bases at once.

This may be seen conveniently by ference to the truth table definition of e gated R-S flip-flop shown below. gain the subscript "n" indicates values rior to the input pulse, and "n+1" indiates those afterward:

SG	RG	Y_n	$\bar{Y}_n$	Y_{n+1}	$\bar{Y}_{n+1}$
0	0	1	0	1 } Y_n	0 } $\bar{Y}_n$
0	0	0	1	0	1
1	0	1	0	1	0
1	0	0	1	1	0
0	1	1	0	0	1
0	1	0	1	0	1
1	1	1	0	?	?
1	1	0	1	?	?

The logic polarity conventions used ere are indicated in figure 4.

In applications where the "ambiguous" G=SG=1 situation can occur, the determinate behaviour of the gated R-S p-flop in this situation can often be nbarrassing, if not intolerable. For such oplications it is therefore necessary to xtend the basic flip-flop concept still rther by equipping it with a means hereby it behaves in a predictable way hen presented with such ambiguous nstructions."

A development from the gated R-S p-flop which is provided with such a echanism is the so-called **"J-K flipop."** This behaves exactly as the gated S flip-flop for all other conditions, but the "ambiguous" situation it behaves edictably by "toggling" or "compleenting"—i.e., switching over from its isting state to the other state.

Figure 5 shows the circuit of a simple K flip-flop developed from those shown the previous diagrams, together with usual logical symbol. It may be seen to be rather similar to the gated R-S flip-flop; the main difference lies in an additional set of gating resistors and diodes, deriving internal gating signals from the J-K flip-flop's own output and complementary output. A small additional difference is that the external gating terminals are now labelled "J" and "K" rather than "SG" and "RG."

The function of the additional gating components may be visualised fairly easily: when J and K are both at logical 1 (=OV), the flip-flop provides its own gating. The output terminal at logical 1 (here equal to +9V, as the **output** logical convention is positive) closes the gate to its associated transistor, routing the input pulse to the other transistor.

As the latter will be the "on" transistor, the negative-going input pulse will thus turn it off and cause the flip-flop to switch over. Thus when J and K are at logical 1 the J-K flip-flop simply switches back and forth for each input pulse. This is termed the **toggling or complementing mode** of operation.

For the three other possible combinations of values for J and K, the circuit works in exactly the same way as did the gated R-S flip-flop. If both J and K are at logical 0 (=+9V), both input gates are closed and the flip-flop is unaffected by the input pulse; if one or the other is taken to logical 1, it opens the associated gate.

The truth-table definition for the J-K flip-flop thus becomes as below, where the subscripts "n" and "n+1" have the same meanings as before:

J	K	Y_n	$\bar{Y}_n$	Y_{n+1}	$\bar{Y}_{n+1}$
0	0	1	0	1 } Y_n	0 } $\bar{Y}_n$
0	0	0	1	0	1
1	0	1	0	1	0
1	0	0	1	1	0
0	1	1	0	0	1
0	1	0	1	0	1
1	1	1	0	0 } $\bar{Y}_n$	1 } Y_n
1	1	0	1	1	0

The logic polarity conventions used here are also the same as before. Note that the J-K flip-flop has a predictable output for all possible input contingencies; also that where the J and K inputs are not identical, the value of the Y output becomes identical with that of the J input terminal.

At this point it may be worthwhile to point out a fact which astute readers will no doubt have realised already. This is

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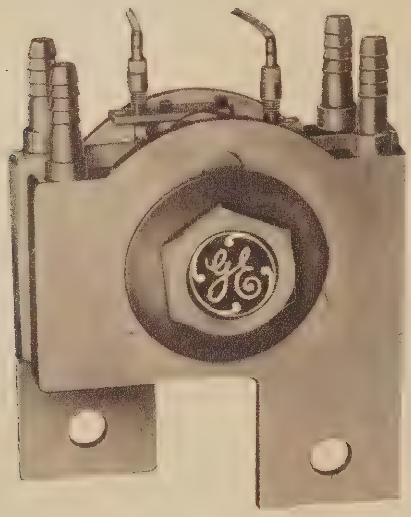

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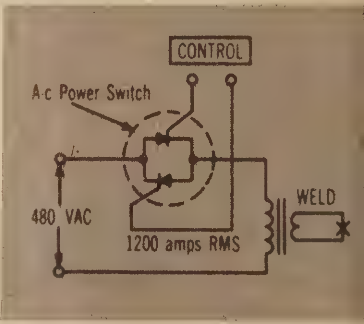

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at the gated R-S flip-flop can be arnged to perform the above self-gating nction simply by connecting its SG d RG inputs to the Y and Y-compleent outputs respectively. However, hen this is done the gated R-S flip-flop ecomes capable of only toggling or mplementing mode operation, as it has nly one set of gating components.

Thus it may be seen that while the ated R-S and J-K flip-flops may be qually suitable for a great many appliations, the J-K variety has a greater umber of potential applications by irtue of its greater flexibility and fully redictable behaviour. However, for ost of the applications to be discussed the remainder of this article the two pes would be equally suitable.

In concluding this introductory disussion of flip-flops it should perhaps e noted that the simple circuits given figures 2, 4 and 5 should by no means e taken to represent the only possible rcuit configurations capable of perrming the R-S, gated R-S or J-K funcons. While quite practical and suitable r experimental and demonstrational urposes as will be discussed later, in the llowing article, they are in fact very mple examples of the three most comon flip-flop types.

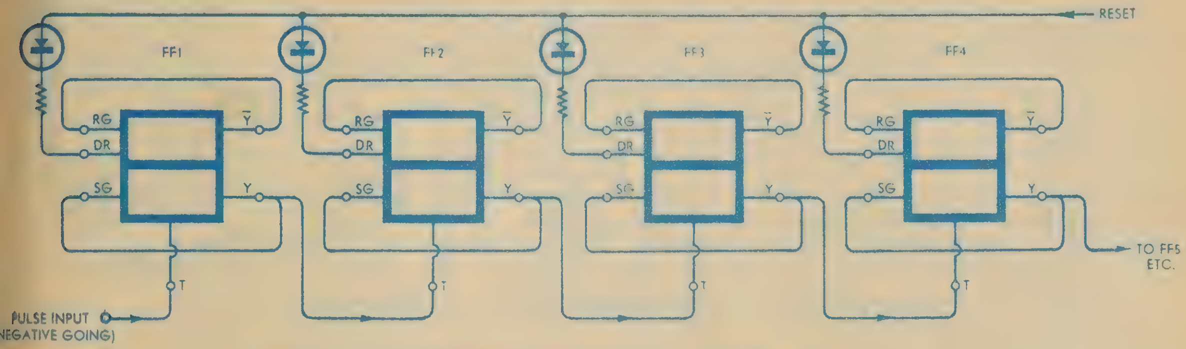


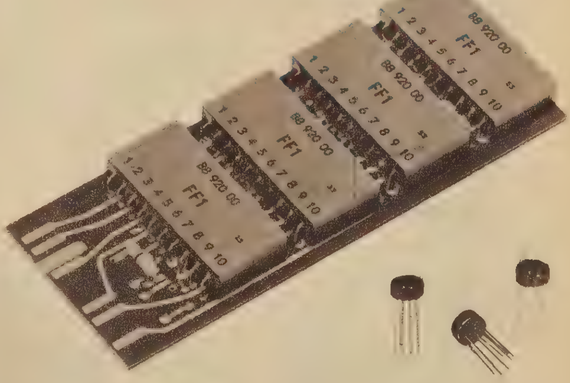
Fig. 6 RIPPLE-CARRY "UP" COUNTER USING GATED R-S FLIP-FLOPS

Commercial flip-flop elements are ten considerably more sophisticated an these simple circuits, although the asic operation may be very similar. artly the sophistication and complexity ises from the need to make elements hich are capable of operating at exemely high speeds; however, circuit mplexity sometimes proves a necessity order to obviate the need for certain mponents which may be hard to prode within the selected method of fabcation.

An example of the latter occurs in the se of integrated microcircuit flip-flops “monolithic” construction, where all rcuit functions are performed by strucres fabricated from a single chip of licon typically measuring only 0.15in x 075in.

Because it proves difficult to provide en modest values of capacitance withut increasing the size of the monolithic ip to an embarrassing size, the degner finds it necessary to alter the basic rcuit configuration so that operation is hieved using only very small capacince values — often the internal capacince of transistor or diode elements.

Usually this involves extra transistor d diode functions; commercial microrcuit J-K flip-flops can thus involve as any as 30 micro-transistor elements, though some designs have less than alf this figure. Commercial discrete-component and microcircuit flip-flops are pictured on this page.



Repeated from an earlier article in the series, these pictures show typical commercial counting elements. The units mounted on the board are discrete-component flip-flops; the smaller units are integrated-microcircuit flip-flops. (Courtesy Mullard-Australia Pty. Ltd., and Fairchild Australia Pty. Ltd.)

Although the R-S, gated R-S and J-K flip-flops are probably the most common types encountered, they are by no means the only types. Apart from other basic types differing slightly from these three in mode of operation, there are also combination elements having virtually two or more basic flip-flops interconnected. However it will be found that familiarity with the R-S, gated R-S and J-K types will make it fairly easy to follow the operation of any other types encountered.

Having looked in some detail at the flip-flop as a representative bi-stable circuit element, then, let us now turn to examine some of the ways in which such bi-stable elements are used to perform counting. In general, there are two main methods of counting with bi-stable elements: so-called “ripple-carry” counting, and “shift” counting. The first of these will now be discussed.

Ripple-carry counting takes its name from a “rippling” or successive carry-over effect which occurs in this type of counter when the last of an even number of pulses enters the chain or **“register”** of bi-stable elements.

A ripple-carry counting register consists of a chain of bi-stable elements, each operating in the “toggling” or complementing mode and connected to the succeeding elements in a manner such that a pulse is passed on to the succeeding elements on every second switch-over. Figure 6 shows the logic diagram of a ripple-carry counting register using flip-flops.

As the flip-flops must operate in complementing mode they may be either J-K elements having the J and K inputs tied to logical 1, or gated R-S elements having the SG and RG inputs tied to the Y and Y-complement outputs respectively. Gated R-S elements are shown in the diagram of figure 6.

The operation of such a register is not hard to follow if it is remembered that the “T” input of a flip-flop is activated only by negative-going pulses. (It is quite feasible to design flip-flops to accept positive-going pulses; such flip-flops would simply involve polarity conventions opposite to that assumed in the following explanation.)

Prior to the arrival of input pulses, all elements are reset to Y=0 by feeding a logical 1 (=+9V) to their direct reset (DR) terminals from the common reset line via isolating diodes and resistors. The arrival of the first negative-going input pulse thus causes FF1 to complement, so that its Y output switches from logical 0 (=0V) to logical 1 (=+9V).

Despite the interconnection between Y of FF1 and T of FF2 this transition does not affect FF2, because it is positive-going. Thus a single input pulse simply sets FF1 at Y=1 and leaves the remaining flip-flops at Y=0.

However, the next input pulse to arrive has a slightly more profound effect. It causes FF1 to complement again, returning its Y output to logical 0—and because this transition is negative-going, it provides a negative-going input pulse for FF2. Thus FF2 complements, its Y output switching from 0 to 1. However, as this is a positive-going transition no carry is propagated to FF3.

Thus after two input pulses have been received FF2 is in the “set” or Y=1 state, while all other flip-flops—including FF1—are in the “reset” or Y=0 state. (Note that the words “set” and “reset” are used to describe both the Y=1 and Y=0 states, as well as the

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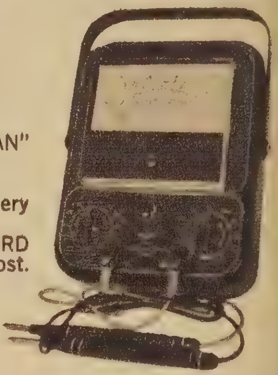

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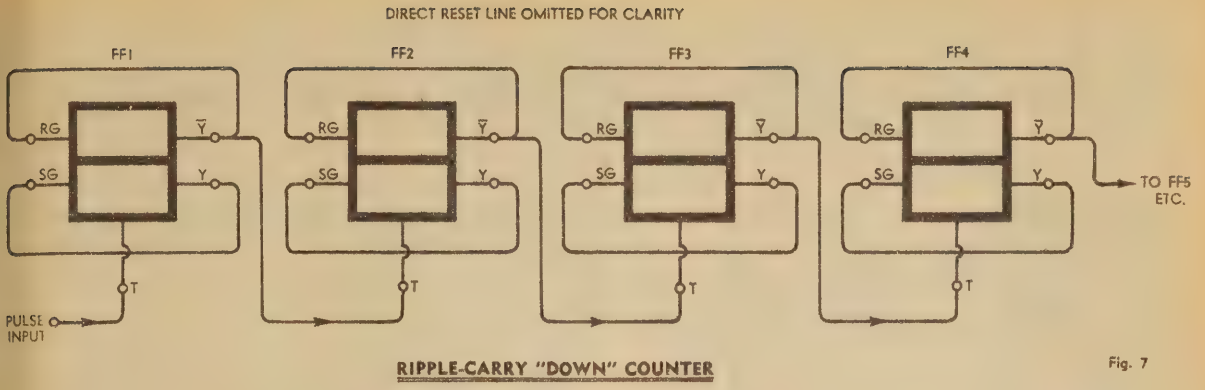

RIPPLE-CARRY "DOWN" COUNTER

Fig. 7

When connected in this fashion, gated R-S or J-K elements perform pure-binary "down" counting.

operations involved in adjusting the flip-flop to these states.)

The third pulse to arrive produces as few transitions as did the first. It simply causes FF1 to set to Y=1 once more, leaving the register with FF1 and FF2 set but all remaining flip-flops in the reset state.

However, the fourth pulse to arrive has an even more profound effect than the second. First of all FF1 is caused to reset; but as this is a negative-going transition at the Y terminal, a pulse is propagated to FF2. As FF2 is already set (by the second input pulse), it therefore resets also; and as this in turn involves a negative-going transition of its Y terminal, a negative-going pulse is propagated to FF3. As the latter has to this time remained reset, it is thus complemented to the set position.

Thus after the fourth pulse the register is left with FF3 set but with all other elements including FF1 and FF2 reset.

In similar fashion the fifth input pulse leaves FF1 and FF3 set; the sixth pulse leaves FF2 and FF3 set; the seventh pulse leaves FF1, FF2 and FF3 all set; the eighth pulse resets all three to set FF4, and so on.

A little thought will show that every **odd** input pulse will complement FF1 alone, while every **even** pulse will complement (in turn) both FF1 and FF2. Similarly every **alternate** even pulse will complement FF1, FF2 and FF3 in turn, and every **fourth** even pulse will complement all four in turn. This can be conveniently represented by the table below, where the values in each flip-flop column represent the value of the Y output of that flip-flop following the input pulse concerned:

INPUT PULSE	FF4	FF3	FF2	FF1
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0

The flip-flop positions are laterally transposed in the table to emphasise a fact which the astute reader may by this point have realised: that the simple ripple-carry bi-stable register counts in "pure binary" notation. Examining the table it will be seen that FF1 has the weight of a "1" register, FF2 that of a "2" register, FF3 that of a "4" register, FF4 that of an "8" register, and so on. As the four flip-flops represent four binary bits, they are capable of counting from decimal 0—15.

Thus in general a register of N flip-flops connected in this fashion will count up to M pulses, and the Nth element will have a binary weighting of W; where

$$M = 2^N - 1 \qquad \ldots (1)$$

$$W = 2^{N-1} \qquad \ldots (2)$$

After M pulses have been received, all N flip-flops will reset and the cycle will begin over again. From this it may be seen that the ripple-carry counter is quite suitable for **scaling** and **frequency division** as well as counting. When used for frequency division, each flip-flop virtually acts as a ×2 frequency divider.

A ripple-carry counter of the type shown in figure 6 is known as an "up" or "feedforwards" counter because it gives a binary registration of the input pulses which **increases** in standard binary notation. However, by making a slight change in the flip-flop interconnections it is possible to produce a configuration which performs "down" or "reverse" counting—wherein the binary registration **decreases** with each successive input pulse.

Figure 7 shows the altered configuration. All that has been done is to take the carry-over signals in each case from the Y-complement terminals rather than

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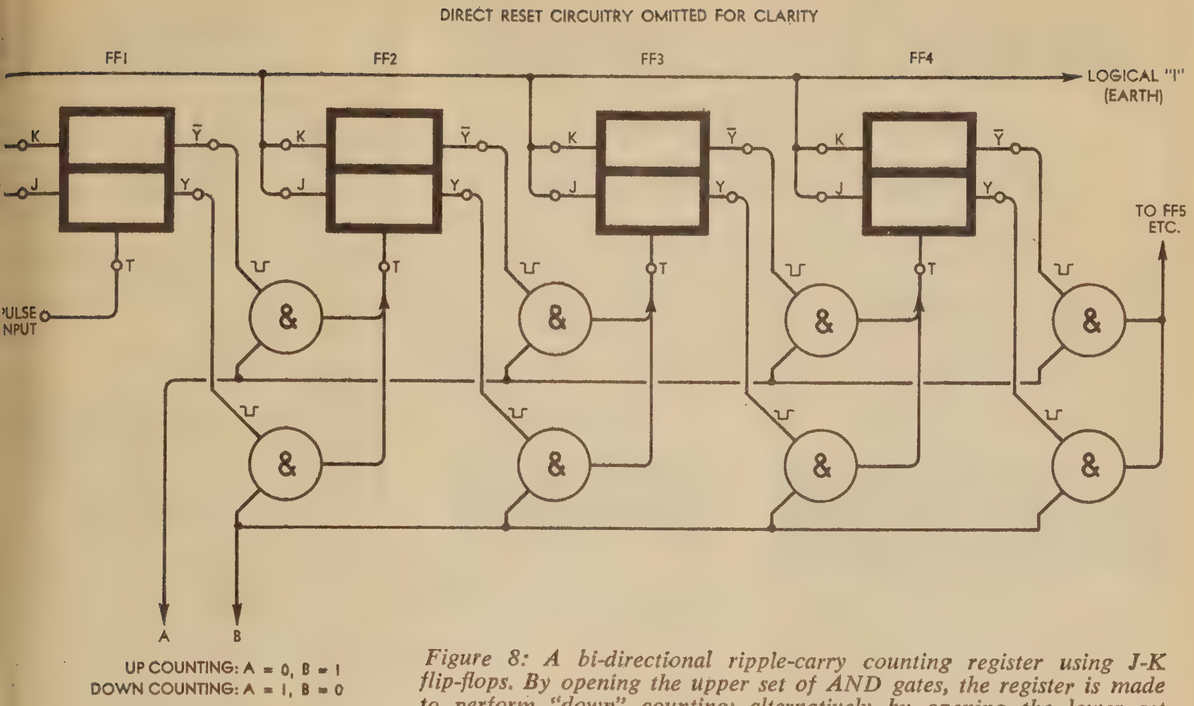
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ULSE NPUT
A
B
UP COUNTING: A = 0, B = 1
DOWN COUNTING: A = 1, B = 0

Figure 8: A bi-directional ripple-carry counting register using J-K flip-flops. By opening the upper set of AND gates, the register is made to perform "down" counting; alternatively by opening the lower set of gates it will perform "up" counting. The J-K elements are operated in complementing mode by connecting both J and K inputs to logical 1.

om the Y terminals. This produces rry-over on reset-set transitions ther than on set-reset transitions as ccurred before. If readers care to check e effect of this they will find that each lse will result in the **subtraction** of e bit from the binary registration.

Thus if the four-bit binary register own is initially reset to 0000 (decimal also decimal 16 and multiples there-), the first input pudse will set all flip-ops to give 1111 (decimal 15). The cond will reset FF1 to give 1110 (deci-al 14), while the third will give 1101 ecimal 13); and so on.

It is possible to make a **bi-directional** pple-carry counter by using two sets of ND gates to alternatively perform the rry-over interconnections. The logic agram for such a counter is shown in gure 8.

Here for "up" or forward counting, a is applied to line B and a 0 to line , rendering the AND gates connected the Y outputs operative. Alternatively r "down" or reverse counting a 1 is plied to the A line and a 0 to the B e—rendering the Y-complement gates erative. The AND gates used for this rpose might possibly be of the diode-pacitor type shown in figure 3.

Note that the flip-flops shown in figure are of the J-K variety, with inputs J d K taken to logical 1 to produce the mplementing mode of operation. This s been done both in the interests of arity and also to illustrate how the K element is used for ripple-carry unting.

Readout of the count contained by a pple-carry register is simply a matter sensing the state of each of the bi-ble elements. This may be done by nnecting low-loading indicating lamp rcuity to each flip-flop output, either rectly for binary readout or via de-ding circuitry for decimal readout.

Thus if the flip-flops used are those own in figures 4 or 5 and described the next article, binary readout may be performed using the indicating NOR gates provided on the first demonstrator panel. As the NOR elements contain inversion, they are connected to the Y-complement flip-flop outputs to indicate the desired $Y=1$ state.

Decoding circuitry and more elaborate readout methods will be discussed and described in later articles.

It should be apparent from the foregoing brief discussion of ripple-carry that this method is a relatively straightforward way of utilising bi-stable elements for binary counting. And as such, ripple-carry counting finds extensive use in digital instruments and computing.

However, the time delay involved in a long ripple-carry register, when the input pulse virtually "ripples" along the chain of elements, and the time necessary for all elements to settle down after the arrival of the last ofa large even number of pulses, make this method rather unsuitable for applications where counting must take place at extremely high speeds.

Although it is possible to reduce the delay of this type of counting circuitry by special techniques, it is usually simpler where high-speed operation is required to forsake the ripple-carry counting method in favour of the second main method, which as mentioned earlier is known as **shift counting.**

The following article in this series will discuss shift counting techniques, including the "normal" and "twisted" ring counters. It will also deal with methods used to perform counting in the binary-coded decimal or "BCD" codes, and will describe the construction of a second panel for the digital demonstrator/breadboard unit.

(To be continued)

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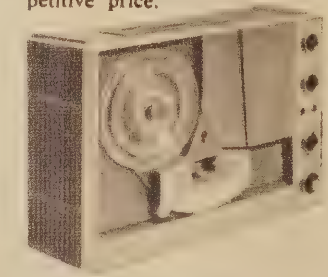

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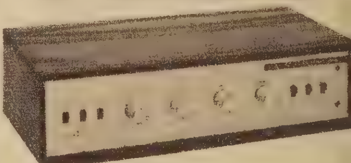

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A Look At Transistor Oscillators

The following article contains a list of transistor oscillators, which we have found to be very useful for quite a wide variety of applications. These circuits are presented with the idea of bringing together in convenient form, proven circuits, which we feel will be of interest to readers. Sufficient information is given at least to form a guide for further investigation.

By Ian Pogson

With transistor-operated equipment ery much established, the natural trend s to displace valves with transistors vherever possible. The reasons at least n part, are not difficult to see. Some f the more obvious ones are: (1) less pace is required; (2) greater efficiency, oupled with lower power supply reuirements; (3) less heat is generated, vith its attendant difficulties and (4) cost nd space taken up by the power supply re also reduced.

More than likely, some readers have ooked around for information on ransistor oscillators, both crystal-ontrolled and self-excited. The self-xcited oscillators may be further livided into variable frequency types and hose intended to operate on a fixed requency.

Regardless of the type of transistor scillator required, you have possibly ad a similar experience to that of the vriter. A search through text-books and ther possible sources will often lead to circuit of one kind or another but, nore often than not, it does not meet he need. This can apply, typically, to he requirement where a crystal must ave one side earthed. Similarly when he oscillator is to be continuously varible, a tuning capacitor must have its otor plates earthed. There are other ossible requirements, too numerous to nention.

A number of projects which we have n mind and hope to describe in the ot too distant future, involve the use of ransistor oscillators, both crystal-ontrolled and self-excited. Some of hese requirements call for crystal oscilators on 100KHz, 455KHz, 1MHz and p to 23MHz or so.

Self-excited oscillators in which we re particularly interested include 100 o 150KHz variable, 455KHz fixed, 2 o 2.5MHz variable, 3 to 3.5MHz varible, and one in the VHF range up to bout 80MHz.

What follows is more or less a report s to how we went about getting oscilators to suit our needs, along with some igures on the performance of some of hese circuits. No attempt has been made o treat the subject exhaustively, as this vould be a very big undertaking and vould occupy more time than we have t our disposal.

Some oscillators which we present, vill appear in more detail than others enerally because we have spent more ime on them. However, every one has een found to be a satisfactory arrangenent. In all cases, sufficient information s given to at least form a good starting oint for readers who have a use for any particular circuit.

We will deal with crystal-controlled scillators first. Some details have aleady been given for circuits suitable for operation with 100KHz crystals, in the issue for June, 1966. Although we will not repeat the treatment of the unijunction oscillator, more can be said about the circuit used for the 100KHz Crystal Reference oscillator, given on page 63 of the same article.

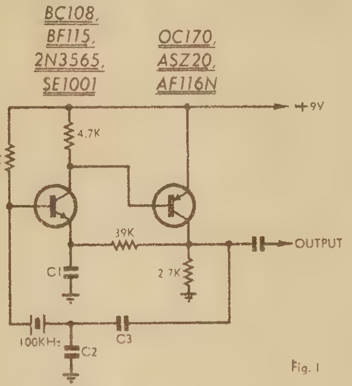

Fig. 1

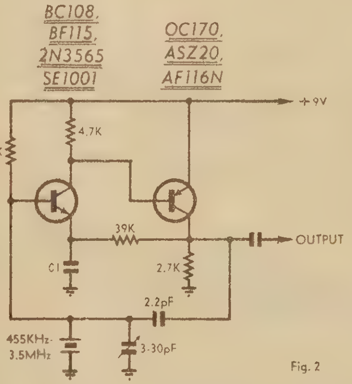

Fig. 2

This circuit has been used for crystals up to 3.5MHz. Above this frequency, operation may be erratic and, unless particular care is taken to be sure that all is well, we do not recommend it under such conditions. one important point, which should be noted, is the fact that, when 100KHz crystals are used, they are connected in series with the feedback loop. For frequencies between 455KHz and 3.5MHz, the crystal is connected in shunt with the feedback loop.

The general circuit for 100KHz crystals is shown in figure 1. For the majority of crystals, C1 will be .01uF. C2 should be a good quality air trimmer covering the range, 3-30pF. C3 should be a ceramic NPO of 10pF. To be a little more specific, C3 should be kept to the lowest value possible, consistent with reliable oscillation. If this capacitor is too large, the circuit may "take off" at some other frequency outside the control of the crystal. C2 is used to adjust the frequency of oscillation to zero beat against a known standard.

It is possible to use various combinations of transistors in this circuit, provided that the requirement is met of using an NPN type in the first stage and a PNP type in the second stage. We have used such types as BC108, BF115, 2N3565 and SE1001, in the first stage. In the second stage, such types as OC170, AF116N and ASZ20 have been used successfully.

If you happen to have a rather old type of crystal, it may not oscillate with these values. An old AWA crystal in a round flat holder, would not oscillate in this circuit, but it was quite content to oscillate in its valve circuit. With C2 a 68pF NPO ceramic, C3 a 3-30pF trimmer and the supply voltage raised to 12 volts, the crystal functioned very well and it could be adjusted to the correct frequency.

Once again, an AWA crystal came up for our attention. This time it was one of the modern vacuum mounted types. Compared with the old one just referred to, the vacuum mounted crystals are very active and need somewhat different treatment. C1 may be reduced in value, which amounts to introducing certain amount of negative feedback. A value of .0056uF should be satisfactory and the crystal may still oscillate even with a .0033uF in this position. The negative feedback tends to clean up the wave-form, so that it approaches a sine wave. As this crystal is plugged into an octal socket, C3 is not needed, as there is enough stray capacitance between the pins to maintain oscillation.

A special case involving the same type of crystal came to our notice. This crystal had been over-driven in the past and one corner was chipped off. The crystal would still oscillate but, when used under normal conditions, its frequency was about 102KHz. By using a .01uF for C1, a 10pF for C3 and a 60pF trimmer for C2, it was possible to bring the crystal back to 100KHz. This is quite a long way to "pull" a crystal on this low frequency, but it shows just what can be done with an active crystal. Perhaps some readers may find some use for such a facility, in that a 100KHz crystal may be shifted in frequency by at least 2KHz and, when multiplied, the shift can be quite considerable.

Figure 2 shows the same type of circuit, but modified for crystals from 455KHz to 3.5MHz. As mentioned earlier, the crystal is connected in shunt with the feedback loop. The 2.2pF capacitor is a general value and should be increased if necessary to obtain reliable oscillation. At the same time, the value should be kept to a minimum, consistent with reliable oscillation, otherwise the circuit will probably oscillate outside the control of the crystal. The 3-30pF trimmer is used to adjust the frequency of the crystal against a standard.

Figure 3 is a combination of figures 1 and 2. There are often cases where a 100KHz and a 1MHz set of reference crystals is required. By switching the appropriate crystal, both frequencies can be obtained from the one oscillator. The foregoing remarks apply to circuit values which should be adjusted to suit each individual crystal which is to be used.

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Reg Boyle

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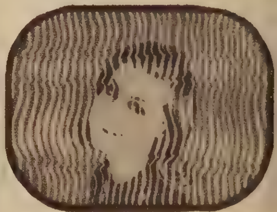

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It is not at all necessary to stick to e two frequencies just mentioned. In ct, by suitable switching, any number f crystals may be used in the one comon circuit. With a little care in conruction and adjustment, it is quite easy obtain a very useful device for freuency checks. The stability on a shortrm basis, should be of the order of a w parts in 10MHz.

Another oscillator which has a useful lace in the scheme of things, is the utler. In valve form, it has been with s for quite a time now, but the transtor version is much more recent. The mple version, without any tuned ciruit, is the one which we have investigated. Provided that a crystal is reasonably ctive, it will oscillate in this circuit, hich is shown in figure 4.

In the Butler circuit, the crystal is onnected in series with a positive feedack loop, between the two emitters. In rder for oscillation to occur, the impednce between the two emitters must be w. This means that the crystal is operted in its series mode. When operated his way, it is possible to achieve above verage frequency stability. By placing a rimmer in series with the crystal, the requency of oscillation can be pulled omewhat from its series mode and this ethod may be used to change the freuency slightly so that it may be brought zero beat against a standard.

Crystals of various types and ranging frequency from 1MHz to 20MHz hich we tried, all functioned vigorously. Ve also tried some FT241 types around 55KHz but they would not oscillate. arious types of 100KHz crystals were lso tried but without success. A tuned ircuit may be inserted in place of the K collector load and, according to Mr utler, it is possible to get crystals to scillate as low in frequency as 50KHz.

In making this change, it is necessary alter the circuit to that as given in gure 5. It should also be noted that it reasonable to suppose that the high andard of frequency stability of the ircuit of figure 4 would not be achieved. s an exception to what we said about hecking circuits earlier in this article, e have not checked the circuit of figure . However, we have no doubts about ne claims made for it.

The harmonic content of the circuit f figure 4 can be quite high, particurly when compared with some other pes which we are considering in this rticle. This characteristic can be a deded advantage when interest centres round harmonics of the fundamental, uch as when frequency markers are reuired at say, 1MHz intervals. This can e achieved up to 30MHz or so, without ny special provisions being made for xtra harmonic output.

By way of contrast, the harmonic connt from the circuit of figure 5 could e much lower, due to the presence of ne tuned circuit. This will depend to me extent as to where the output is ken from the oscillator.

The two oscillators which we have ealt with so far, need two transistors in rder to get the required phase reversal. hese oscillators are also to some exnt, specialised in their application.

Another crystal oscillator, using only ne transistor, is of a more general type. glance at the circuit of figure 6 will ow that it looks very similar to the lve type Pierce. We have had crystals cillating in this circuit, from 1MHz ght up to 20MHz. We did not try crystals higher than this frequency. Considering the other end of the frequency range, we could not get 100KHz crystals, except vacuum mounted types, to oscillate. The type FT241 crystals, around 455KHz also would not oscillate reliably.

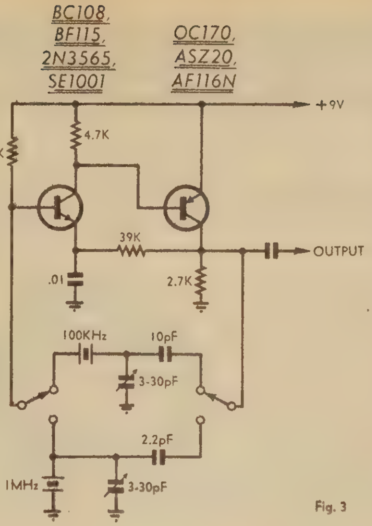

Fig. 3

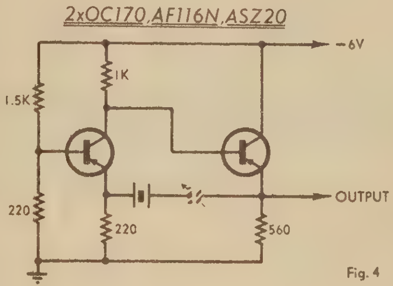

Fig. 4

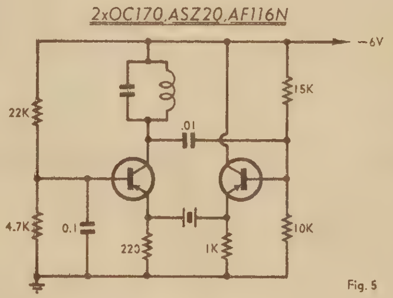

Fig. 5

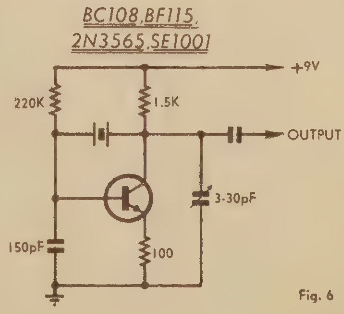

Fig. 6

Although we have shown this circuit as using a silicon NPN transistor, this circuit is also very satisfactory when using a germanium PNP type transistor, such as the AF116N or OC170. Of course the polarity of the supply must be reversed, and the 220K bias resistor should be changed to 680K.

The 150pF capacitor from the base to earth is a good compromise value and is generally satisfactory but it may be possible to improve the output level by changing this value. However, by doing this, it will also change the frequency of oscillation.

The 3-30pF trimmer from the collector to earth is normally used to adjust the crystal to the correct frequency. The maximum value may be increased within reasonable limits, if the crystal is still oscillating at too high a frequency. Regardless of this, it should be noted that there must be a certain amount of capacitance in this position, otherwise the circuit will not oscillate.

In addition to the capacitance just mentioned, it is possible to add a trimmer across the crystal to reduce the frequency. If, on the other hand, the frequency is too low, consistent with a minimum of capacitance from collector to earth, then a trimmer may be added in series with the crystal. This is then adjusted to bring the crystal to frequency.

Considering the simplicity of the circuit, the stability obtainable is very good. One set of measurements that we took, showed that the oscillator stabilised about half an hour after switching on and the total drift was 10Hz, measured at 10MHz. During the next half-hour, the frequency stayed within about 2Hz, at 10MHz. Of course this is a short term check and, so far, we have not made any long term measurements.

The crystal used for this check was

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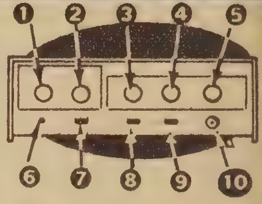

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MCX 4

an old type 1MHz, mounted and free to move between its holder plates. Although the figures obtained are good, this particular type of crystal is not really satisfactory, as a bump will shift the crystal in its holder and the frequency can change by some 20Hz or so, at 10MHz. Modern crystals that are not free to move in the holder should be capable of giving very satisfactory results.

One further point that we have noted with this oscillator when operating at 1MHz is that the wave form is quite a clean-looking sine wave, as viewed on a CRO with a bandwidth of 4MHz. If an oscillator with such a waveform is needed, then this one should fill the bill. Needless to say, the harmonic output is low and if harmonic content is wanted, then some form of harmonic generator should be added, or another type of oscillator should be used.

More recently, our attention has been drawn to yet another oscillator, which appears to show considerable promise. The general circuit is shown in figure 7. It will be seen to consist of a bridge arrangement, one leg of which is frequency conscious. This bridge is connected between the input and output of an amplifier of two stages.

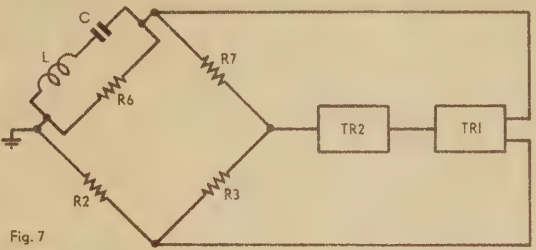


Fig. 7

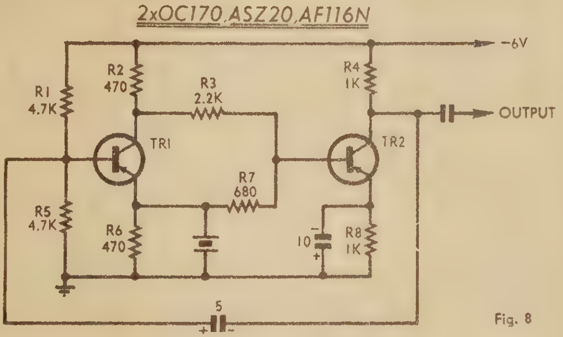
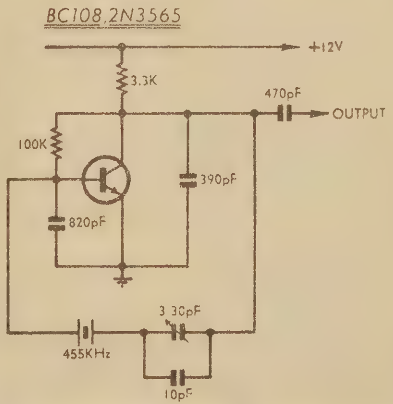


Fig. 8



Under conditions when the series LC circuit is off resonance, it appears as a high impedance across R6. R2, R3, R6 and R7 values are so chosen that the bridge is unbalanced, which results in negative feedback. At resonance of the series LC circuit, this becomes virtually a short circuit across R6. This change of conditions results in an unbalance of the bridge, such that a positive feedback circuit is introduced, so giving rise to oscillation.

It is claimed that, by careful design, the circuit can be made virtually immune from changes in the transistor parameters due to temperature changes. Changes in loading also should not affect the frequency of oscillation. This means that the frequency of oscillation is substantially dependent upon the characteristics of the LC circuit, and any frequency drift would be due to temperature changes of this circuit.

This all looks very good from the point of view of obtaining a stable VFO and more will be said about this later on. Meanwhile, we have replaced the LC circuit with a crystal and the detailed circuit is shown in figure 8.

We have tried crystals in this circuit, ranging in frequency from 1.5MHz to 12.5MHz. Those crystals which were tried, consisted of the more modern plated types, as well as the old FT243 type. The latter one oscillated just as vigorously as the former. The output voltage, with a —6 volt supply, was about 0.75 volt RMS.

Unfortunately, due to lack of sufficient time, we have so far been unable to check this circuit in any great detail. For example, the idea of introducing a trimmer into the circuit to adjust the frequency by a small amount has not been tried. However, the idea of connecting a trimmer either in series, or in parallel with the crystal, should not be overlooked and would be well worth a trial. With such checks being successful, the idea of using the circuit for a crystal reference oscillator would be well worth following up.

The amount of feedback may be changed by altering one or other of R3 and R7. The feedback may be increased, by increasing the value of R7 or by decreasing R3. The reverse procedure will naturally apply, when the feedback is to be reduced.

Before leaving this circuit, it will be noted that we have specified germanium PNP transistors, type OC170, or similar. There is no reason why silicon NPN transistors should not be used, but it will be found necessary to change some circuit values, particularly as relates to bias.

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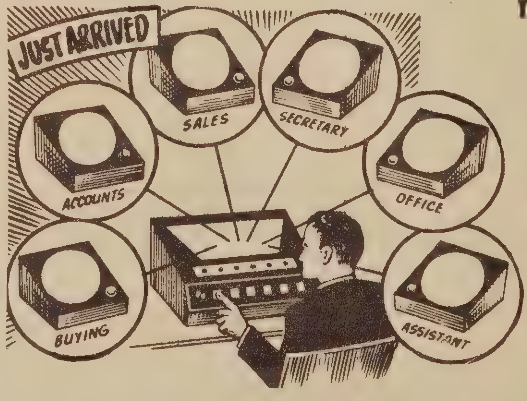

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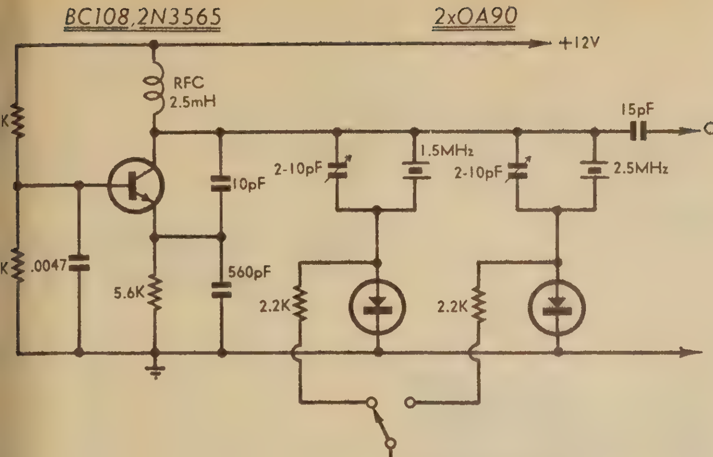

Fig. 11

55KHz, and is shown in
gure 9. The other as shown
figure 10, is suitable for
equencies covering at least
om 1.5 to 12MHz, which
the range in which we are
terested.

The circuits as shown,
ve been modified slightly
om those submitted by
e, in that the original cir-
its called for germanium
C171 type transistors. The
anges have been made
here necessary to get
otimum performance from silicon
ansistors. We have tried both circuits,
ing gold-plated crystals, in style "D"
olders, and the results have been very
easing. Due again to shortage of
me, we have not yet checked the per-
rmance of other types of crystals,
rticularly the older ones, in these
rcuits.

The need arose for us to be able to
vitch between two crystals, used in the
e oscillator, for the purpose of side-
nd switching. The switch was to be
cated on the front panel, and the oscil-
tor near the back of the chassis. This
eant either very long leads, which can
ad to trouble, or the switch could be
cated close to the circuit, with an
tension shaft to the front panel.

An alternative arrangement, avoiding
th the mechanical and electrical prob-
ms, is to use diode switching as shown
figure 11. The long leads are then
ly required to carry DC.

Each crystal, with its trimmer shunted
ross it, is connected in series with a
rmanium diode. Under these condi-
ons, neither crystal will oscillate. How-
er, it is only necessary to bias one of
e diodes into conduction, thus reducing
internal resistance, which allows its
ystal to oscillate.

The biasing current is conveniently
awn from the 12-volt supply line. The
ltage is applied to the diode through
2.2K resistor, which performs the
al function of isolating the crystal
om external circuitry, and providing
resistor to limit the current through
e diode to a convenient value.

Switching from one crystal to the
her, then becomes a simple process of
vitching the 12 volt DC supply to the
propriate diode. The 2.2K resistor of
e unused circuit is simply left "in
id-air," which is sufficient to prevent
at crystal from oscillating.

Part two of this article goes into some of the details of self-excited transistor oscillators, from 100KHz to 80MHz.

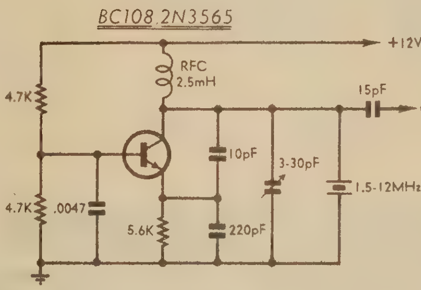

Fig. 10

(To be continued)

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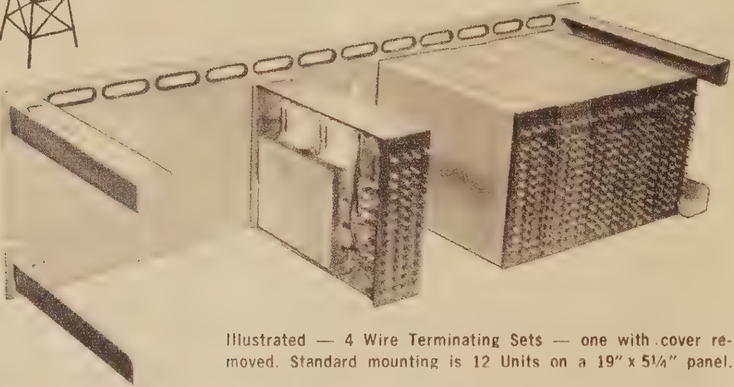

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Another Look at Electronic Flash

One of the regular requests in our mail is for an electronic photoflash unit; a project we have not been able to present to our readers for a number of years. However, recent developments suggest that this is a good time for us to take another look at this possibility.

By Philip Watson

Our main reason for not attempting such a project in recent years has been the difficulty of ensuring reasonable supplies of the rather special components involved in such a project.

After all, there is not much point in spending a lot of time developing such a unit — even assuming that we are able to gather together enough bits and pieces to make "one off" — if the reader, when he comes to duplicate it, is unable to buy the same bits and pieces. Nor is there much purpose in the effort if the parts, in aggregate, cost more than an equivalent commercial unit.

The components most likely to present problems are the flash tube, the reflector and the main storage capacitors. Another problem, partly one of supply and partly one of design, concerns the best type of battery to use from what is available. Fortunately, this is less of a problem now than it once was.

It is against this background, and prompted by readers' letters, that we have made inquiries from time to time in an effort to discover whether the supply position was any better. Unfortunately, there always seemed to be one item or another which presented a "bottleneck" and we were forced to shelve the idea yet again.

More recently, we looked at the situation again, prompted this time by the development of a particularly attractive transistor power supply unit by Mr John Longfoot of the Philips Miniwatt laboratory. And when this organisation suggested that we might develop a complete unit around this supply, and turned over to us a sample power supply with all relevant technical data, we felt that the time had come to stir the matter up again and see if we couldn't persuade those concerned to organise supplies of vital components.

The result has been a lot of telephoning and a lot of interviews; and, we must add, a lot of co-operation by sections of the trade concerned. Some problems remain but the position looks a good deal brighter than it did a little while ago; at least sufficient to encourage us to take the first step towards the description of a complete unit.

This, we felt, could best take the form of a general discussion of the basic principles of flash units, followed by a detailed description of the Philips Miniwatt power supply. Then, if all the promises which have been made in the past few weeks come good, we will be able to follow this with a further article, detailing the construction of the complete unit.

In the meantime, those readers who are prepared to do some searching on their own account, may well unearth enough components from odd places to justify going ahead with the power supply and producing their own unit, irrespective of our own efforts.

But first, some background:

The history of electronic flash goes back quite a long way, and had its origin in scientific laboratories interested in studying various highspeed phenomena, ranging from bullets in flight to the behaviour of complex machinery, which could only be "stopped" by extremely short photographic exposures.

A typical commercial unit of the more compact variety. The "all-in-one" construction is achieved by skillfully packaging the components and limiting the energy to about 50 joules.

Since the practical limit of mechanical shutters had long since been reached, scientists sought another solution to the problem. If some way could be found to generate extremely short pulses of intense light — much shorter than typical shutter times — then the light itself would determine the exposure time, the shutter serving only as a secondary device.

Strangely enough, the first suggestion along these lines was made well over 100 years ago by William Henry Fox Talbot, one of the pioneers of the art of photography. He suggested that an electric spark might be used as a source of light to photograph very fast moving objects.

But it was more than 40 years later before this was actually tried, when Sir Charles Verno Boys and Professor Mach, in London, used the idea to photograph bullets in flight—a remarkable achievement at the time. Not only did they succeed in stopping the motion completely, but the photographs also showed the air or sound waves created by the bullet.

The present era of high-speed flash commenced about 1928 with the work of Professor H. E. Egerton of the Massachusetts Institute of Technology. Egerton retained the general idea of discharging a capacitor, as had been done to produce the early spark illumination, but made a major contribution by passing the discharge through a gas, causing it to ionise and give forth a brilliant burst of light. The improvement in light output opened up a whole new field of high-speed photography.

Most of us are familiar with gas ionisation, the humble neon pilot lamp, and the neon tubes used for advertising displays being typical examples. Because it is a basic principle of electronic flash, it is worth looking at in a little more detail.

All these devices consist of a sealed (usually glass) container which contains the gas, and two electrodes. If we apply increasing voltage to the electrodes we find that, initially, the resistance between them is extremely high, and virtually no current will flow.

At some critical point, however, depending on the type of gas, its pressure, and the path length between the electrodes, the gas will ionise. Electrons are so strongly attracted to the positive electrode that they are literally torn from their parent atoms. The atoms, now transformed into positive ions by loss of an electron, are similarly attracted towards the negative electrode.

When this happens, the apparent resistance between the electrodes drops to a very low value, sometimes as low as a fraction of an ohm, and the current flow through the gas can be very high; so high, in fact, that it could quickly destroy the tube by reason of intense heat generation.

In practice we may prevent this in one of two ways. If we wish the gas remain ionised and to continue producing light, we deliberately arrange the external circuit so that it cannot deliver a very large current, and the system

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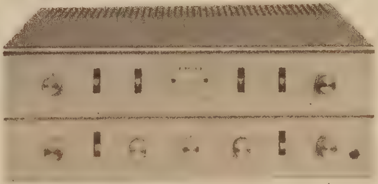

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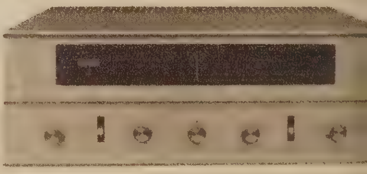

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Manufactured By **TRIO CORPORATION** 6-5, 1-chome, Shibuya, Shibuya-ku, Tokyo, Japan ettles down to a limited operating conition which is quite safe. The neon amps mentioned above are examples of his, the current through them being limied either by a series resistor or inductor.

In the other case we allow the heavy urrent to flow, with intense light outut, but arrange the circuitry so that it asts for a very short period only, no nore than a very small fraction of a econd. This is the system used for hotoflash.

In fact, such operating conditions are uite severe, and the total life of a ypical photoflash tube adds up to only few seconds. However, since each ash is so short, tubes are capable of roducing many thousands of flashes.

The energy for the flash is stored in arge capacitors, and this is the reason hat the flash is of limited duration; as he capacitor discharges the voltage beween the flash tube electrodes drops ntil it reaches a value where the gas e-ionises. Once this happens the tube virtually open circuit again, and the low of current ceases.

Naturally, some means must be proided to fire such a tube at the precise oment required. One system is to imply apply such a high voltage to the ube that the gas ionises immediately, ut this presents a number of problems. he main one is to provide a switching evice which will handle both the voltge and the very high peak current — everal hundred amps in typical systems. 'or this reason, the system is used only n very special cases.

The more usual system uses an perating voltage well below the ionising oltage of the gas, ionisation being nitiated by an auxiliary electrode, alled the "trigger" electrode: this is ed with a brief high-voltage pulse from trigger transformer. Once the gas onises, the trigger circuit has no further ontrol; energy stored in the main apacitor takes over and maintains onisation until the capacitor is disharged.

Since the trigger circuit is a lownergy system it is easily controlled by push button or by synchronised camera ontacts of quite modest current-arrying capabilities.

As far as practical units are conerned, the design has always been rgely governed by the physical size f the main storage capacitors and the ower supply to charge them.

In the early days of development, hen the main uses were for scientific ivestigation and, later, when they were itroduced for studio lighting, power 'as derived from the mains and stepped p and rectified to charge large banks f capacitors. The equipment was ulky and heavy and normally mounted n a wheeled trolley to facilitate moveient.

Nobody worried very much about ulk at this stage, because portable peration had not been seriously condered. When it was, early workers ere influenced by the techniques eveloped for studio units, which they aled down as best they could for ortable use. The result was very much compromise, mainly in terms of light utput. Compared with typical studio stems, the light output was about onenth of a single studio lamp, of which veral would normally be used. And en then the term "portable" was a lative one.

The early tubes were all designed for high-voltage operation, 2,500 volts or higher. This meant that the capacitors had to be paper-insulated oil-filled types which, while efficient, were large and heavy; this, despite industrious effort by the manufacturers to limit their bulk and make the design of portable electroflash units more practical.

Power for such units was taken from batteries within the unit, stepped up to the required high voltage by a vibrator/transformer combination, then rectified to charge the capacitor. By the time all these components had been accommodated, the main power unit usually ended up as a fair-sized pack, probably weighing around 10lb.

Plessey UK
ELECTROLYTIC
PHOTOFLASH
CE 701/14

Typical electroflash capacitors. Each measures 1¾in by 4½in and stores 50 joules. (Photo by courtesy Ducon Division, Plessey Components Group, Villawood, N.S.W.)

This was the state of the art in 1952, when we presented our first Electroflash. Designed around the Mullard LSD3 high-voltage flash tube, it represented quite a step forward for the Australian home constructor and, while bulky by modern standards, was capable of doing a very good job.

As we described the unit, it was designed for operation from a dry (lantern) battery, a small "dry" accumulator, or from the mains when these were available and convenient. Judging by the number of tubes sold, a large number of these units were built and, by all accounts, performed very satisfactorily.

By 1954 the position had changed significantly. Tube manufacturers had broken through the voltage barrier and were producing tubes capable of working down to 250 volts—a development which made possible several changes in the basic approach to the problem.

Probably the most important of these was that it brought the system within the operating voltage range of electrolytic capacitors, making possible considerable saving in both space and weight.

It also made possible a new approach to the power-supply problem. Instead of a low-voltage battery plus vibrator plus transformer plus rectifier, it became feasible to charge the main capacitor directly from a 250-volt battery made up from standard HT dry batteries. And, while such a system is not without its own disadvantages, it is still used by some commercial manufacturers today.

Another effect of the new tubes and the low-voltage, high-capacitance working conditions which resulted from them, concerned the duration of the flash. The ultra high speed of the high-voltage flash—usually 1/5000 second or faster was no long possible, although the speed of the new tubes—about 1/1000 second —was still fast by most photographic standards.

As it turned out, the longer flash duration did not prove a liability. The novelty of photographing breaking electric light globes and high speed fan blades had worn off; the average photographer simply wanted a compact and reliable flash unit for routine work. On the other hand, the longer flash duration had a worth-while advantage—less "reciprocity failure" than with the high-speed flash.

Failure of the reciprocity law, or "reciprocity failure," refers to the fact that, for extremely short exposure periods, virtually all photographic emulsions fail to follow the normal law whereby halving the exposure time can be exactly compensated for by doubling the amount of light reaching the film. For very short exposure periods, considerably more than double the light is needed. Thus, extremely short exposures waste a good deal of the light which the system produces.

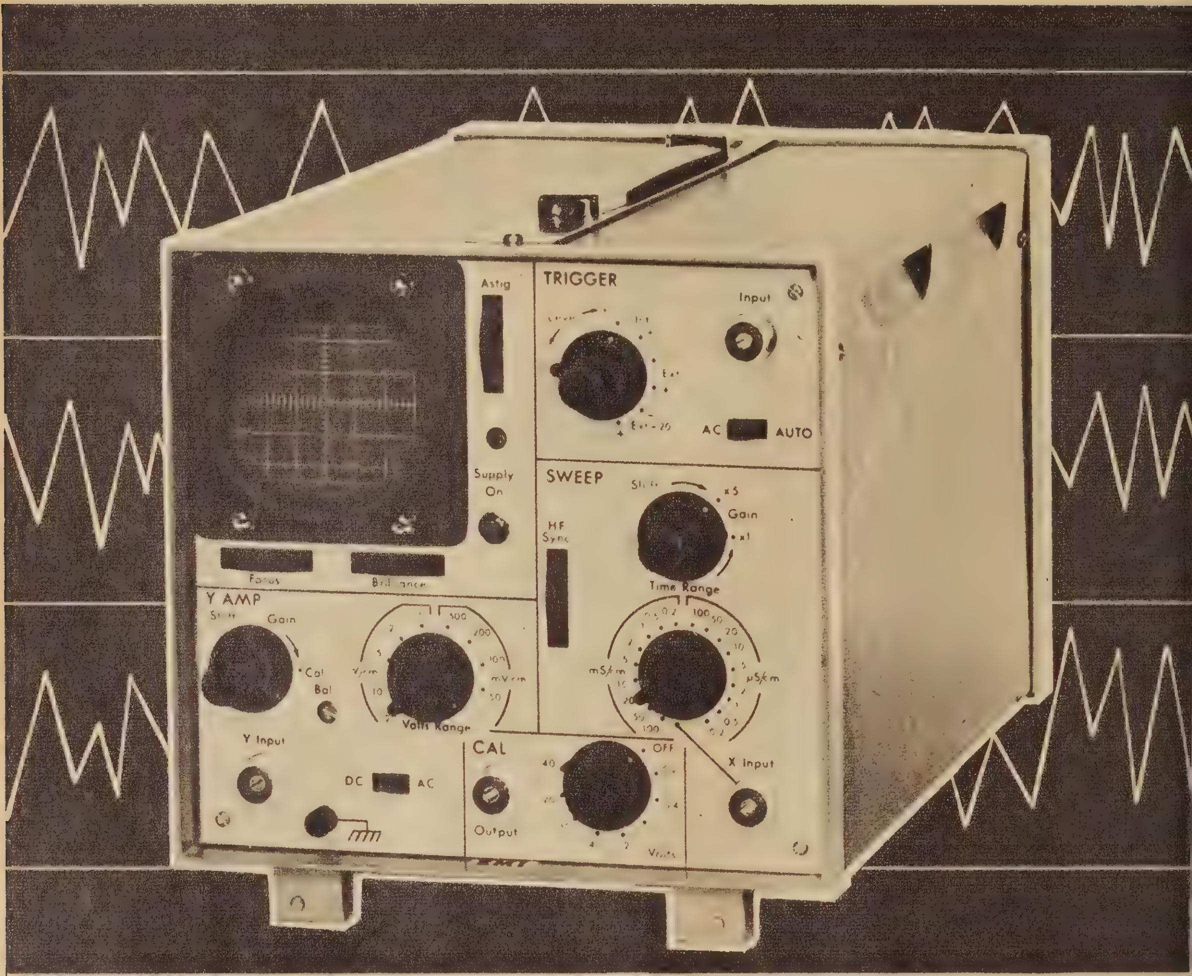
About this time we produced our own Low Voltage Electroflash, designed around the Siemens SF15 tube, operating at 250 volts. It was designed to operate directly from dry batteries, from the AC mains, or from a small accumulator via a vibrator pack. Again, judging by the number of tubes sold, it would seem to have been a very successful project.

The next major breakthrough resulted from the development of transistors and, in particular, the transistor power supply. By increasing the frequency from the old 100Hz of the vibrator to one of several thousand Hertz and employing the recently developed ferrite materials, it became possible to produce a step-up transformer which was only a fraction of the size and weight of the old laminated core variety. At the same time, the weight and space of the vibrator itself was saved.

And, by way of a bonus, it was found that the transistor circuitry was admirably suited to simple automatic control which would enable the capacitor to be charged to and held at the desired voltage, without any supervision on the part of the operator.

The new power supply concept, combined with progressive improvements in electrolytic capacitors, has allowed the electronic flash unit to be scaled down to a degree which would have been difficult to envisage 10 years ago. As a result, there are commercial units available today which are little larger or heavier than the camera with which they may be used—and at very attractive prices.

However, some of this apparent improvement needs to be treated with caution. While it is true that the technical advances described above have contributed a lot to reduction of size and weight, it is equally true that the very small units have achieved what they have at the expense of considerable reduction in energy content. And, while some of the resultant light loss is made up for by highly efficient reflectors, the fact remains that they cannot compare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ith the larger units when big jobs have be done.

On the other hand, it must be adiitted that photographic emulsions have ome a long way in the same time, articularly colour emulsions. In 1952 ie fastest colour film available was ated at ASA 12; or perhaps 20 if you ere daring enough to believe the claims r some of the newer brands on the iarket!

Today, one can buy perfectly satisictory colour film rated as high as 60 ASA, while 32 and 64 are quite ordinary" speeds. And it would be nearly s hard to buy a 12 ASA film today s it would have been to buy 160 ASA 1 1952. As a result, the very small w power units are less of an anomaly han they would have been even 10 ears ago.

All the foregoing leads naturally to onsideration of more precise performnce data for electronic flash systems: low is light output assessed? How does compare with that of typical expendble bulbs? What kind of compromises re required in designing a typical unit? Vhat is the best type of battery for iese units? How fast can the unit be red? What are the advantages and isadvantages compared with expendable ulbs?

The light output of electronic flash nits is usually indicated by quoting the mount of energy stored in the main ıpacitor. This is not strictly accurate, ecause it cannot take into account the ficiency of the flash tube in converting ie energy to useful light, or of the eflector in directing all the light to here it is needed. Nevertheless, for ant of a better standard which is availole to all, the "joule" or "watt/second" oth mean the same) is now generally ccepted as the means of rating these evices.

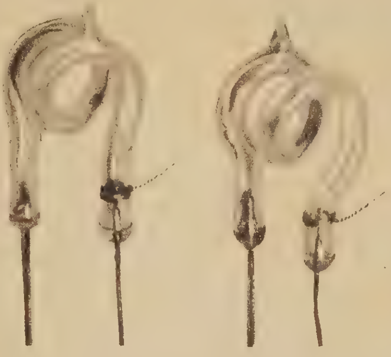
The joule rating of a system can be ilculated quite simply from the value ' the main storage capacitor and the perating voltage, according to the foriula: $J=\frac{1}{2}CV^2$, where (typically) C may e expressed in microfarads and V in ilovolts.

For studio working individual tubes ay be rated from 400 to as high as 00 joules, and there may be several ich light sources used to illuminate a ıbject. For portable work, hower, units are rarely rated above 100 ules, while the very small units menoned earlier may be as low as 20 ules.

How does this compare with typical pendable bulb light output? In some spects, this is a difficult comparison make. On a lumen-seconds basis the pendable bulb would appear to be ell ahead, since the smallest (No. 1) ılb produces 6,500 lumen-seconds, ompared with a typical electronic flash be rated by its maker at 35 lumen-conds per joule, or 3,500 lumen-secıds in a 100 joule system. Even if we ısh the lumen-seconds per joule figure 50, which appears to be justified in me cases there is still a margin in vour of the expendable bulb.

On the other hand, electronic flash anufacturers, no doubt conscious of is fundamental disadvantage, go considerable lengths to develop high-efficient reflectors (something which pendable bulb equipment seems to igre) so that, in practice, the difference not always as great as it may otherse appear.

Nevertheless, the fact remains that the electronic flash, even at the highest energy normally used in portable form, starts off at a disadvantage compared with the expendable bulb, and needs every trick it can use to make up the difference.



A pair of locally made flash tubes rated at 100 joules. (Photo by courtesy Hogan Electronics Pty. Ltd. Camperdown, N.S.W.)

An imported combination flash tube, (125 joule) reflector, and plastic housing. (Photo by courtesy Craftsman Glass Pty. Ltd., Bexley, N.S.W.)

In designing a flash unit, therefore, a designer has to face up to the need for a number of compromises. While it would be nice to increase light output, this can only be done at the expense of more bulk, more weight, more battery drain and a higher first cost. In addition, if the increase in all these is not to become excessive, there must also be an increase in the charging time for the main capacitors; a factor which most users regard as being extremely important.

The charging time, or "recycling time" as it is usually called, depends on many factors; the type of battery used and its internal resistance, the design of the power supply, including the maximum current the main switching transistor will handle, the resistance of the transformer windings, and the losses in the rectifiers. And, finally, if all these factors are made negligible, we must avoid flashing the tube at a rate greater than that approved by the manufacturer.

The need for a fast recycling time is fairly obvious. If the user has to wait unduly long between flashes, it may well mean that important pictures are lost or, at the very least, considerable inconvenience for all concerned while waiting for the system to recharge.

In practice, times can range from two or three seconds for very small units, to 20 seconds or more for larger units operating on partly discharged batteries. The former is faster than need be, the latter too long in many cases, and a practical compromise is probably somewhere in between. Some of the time between shots is taken up anyway by winding on film, rearranging groups, selecting different angles, checking focus, etc., but practiced photographers become extremely adroit at these tasks, and find it irksome if they then have to wait for several seconds for completion of the charge.

One partial solution to the problem is to equip larger units with an alternative "half power" position, which will at least halve the re-cycling time when the full output is not essential .

This feature is also desirable for other reasons, such as the need to reduce light when working very close to a subject. Because the shutter plays no part in the exposure, the diagram alone is available to limit exposure, and this can prove inadequate at distances of a few feet.

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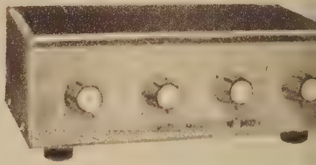

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)iscussion of the re-cycling time leads urally to a consideration of the type of ver supply to be provided, i.e., high tage primary battery charging direct- or low voltage battery plus inverter, , if the latter, should it be any of primary cells currently available,such zinc-carbon, mercury, manganese-zinc? alternatively one of the secondary teries, such as lead-acid — available several physical forms—or nickel-cad-ım?

'he high voltage battery system has advantage of simplicity and relia-ty, good charging time, and low first t. The replacement cost of the battery elatively high but, since it will provide arge number of flashes, the cost per h is probably no greater than with er systems. However, the shelf life of battery has to be considered and, ess most of the flashes are used within time, the greater portion of the tery's potential will be wasted.

.ow voltage primary battery systems m best suited to the smaller portable ts, where the smaller and relatively xpensive zinc-carbon cells may be used discarded after a limited number of hes. Zinc-carbon cells in larger units y give relatively poor charging times, ile the shelf life problem must still be ısidered.

)f the other two primary batteries ntioned, only the manganese-alkaline can be considered in this role, since mercury cell is not designed for ıvy discharge rates. The manganese-aline cell, on the other hands, is ideally ted to this kind of service and, in dition, has good shelf life. Unfortu-ely it is relatively expensive, particu-ly in this country, where it has to be ported. Nevertheless, there would be ny situations where its desirable char-eristics would readily outweigh this.

n the light of all this, it may seem ural to turn to the secondary battery the most logical choice, but even here case is not clearcut. For one thing first cost is higher, and this must be set by a long life if the user is to get ue for money. The lead-acid cell, in ticular, can fail prematurely if not efully tended during its idle periods cluding those before sale) as many an ateur has learned to his cost.

In fact, failure to find a satisfactory ution to the battery problem was just e more reason why we hesitated to scribe a flash unit for home construc-n; we felt we could be encouraging ders to invest in batteries which might ve unreliable and expensive in the g run.

More recently, the ready availability the local market of the nickel-cad-um battery has given promise of some-ng better for this job. While still ding reasonable care, it appears to be less sensitive to long periods of idle-s, particularly if left on trickle charge, it may be for indefinite periods.

'inally, how does the electronic flash t compare with the expendable bulb tem? On the credit side of the expend-e bulb must be placed the low first cost a gun, the high light output, the range bulbs available, and the small size negligible weight of the outfit.

)n the debit side there is, of course, relatively high cost per flash of the bs, plus the inconvenience of having carry bulbs and change them between hes. Nevertheless, for the really casual tographer, the low first cost is a major factor, and more than offsets the higher running cost.

On the debit side of electronic flash is a higher first cost, a more complex piece of equipment which, to the unskilled, may present greater reliability problems, plus bulk and weight to carry around.

On the credit side of a well designed electronic flash is the almost negligible running cost, the convenience of not having to change bulbs, and the short exposure with its ability to minimise subject and camera movement. These three factors alone are so important to commercial photographers covering weddings and social events, that they would not consider any other form of lighting. In fact, the electronic flash has made possible the kind of coverage that these events can now be given.

Another advantage, rather more subtle and not always appreciated until one uses the equipment, is that it is now so easy and inexpensive to use flash that one is encouraged to take flash pictures, particularly in black and white, on a purely experimental basis, since the cost per negative is normally only a few cents. On the other hand, the experience gained, but which one may hesitate to acquire using expendable bulbs, will prove invaluable when really important pictures have to be taken.

In short, for any photographer who takes flash pictures on anything more than a casual basis, or who feels that he could use flash with advantage more often, the credits far outweigh the debits.

So much, then, for our background to this subject. We have dealt with it at some length because we feel that it will give readers a better understanding of both the features and limitations of these devices, and the problems which a designer must face in producing one.

Next month, we hope to describe the operation and construction of the transistorised power supply, and possibly discuss the likely availability of other components in some detail.

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for automatic playing of a stack of up to 10 records with the same diameter, groove type and speed. The automatic operation handles standard 7", 10" and 12" records.

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Automatic Record Player

Single records can be played automatically with the short spindle.

Manual Record Player

The tone-arm may be placed by hand on the stationary or rotating record.

In all types of operation, after completion of pl the tone-arm is automatically returned to resting post, the drive wheel disengaged and power switched off.

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PROGRAM SOURCE with RF STAGE

his article is intended to assist readers
n country areas, who operate high fidel-
y systems but who need something
etter than the usual 2-valve superhet
uner. The new design includes a high-
ain RF stage. Short-wave coverage,
ariable bandwidth, tuning indicator, in-
uilt power supply and whistle filter are
optional features.

By Michael Meechan

A front view of the Playmaster 114 Program Source, housed in a stained timber cabinet of a type made for Playmaster equipment by one of our advertisers (Messrs. Broadway Electronics). Controls (left to right) are: Bandwidth, wavechange and tuning.

In October and November last, we escribed a two-valve superhet tuner he "Playmaster 111 Program Source") tended to meet the need of our many aders living in areas well served by cal radio stations. The design proded for various options, to forestall quiries about facilities differing from ose which could be provided in any e prototype.

In this present article, we seek to give e same sort of guidance, in abridged rm, to the smaller group of readers ho live in remote areas and who need mething with a more ambitious RF rformance than the 111 design.

For such a tuner, the most obvious quirement is an RF stage, with its tential contribution to sensitivity, lectivity and signal-to-noise ratio — ing the last term in its widest sense.

Unfortunately, the addition of an RF age carries a penalty of a kind, beuse the extra selectivity increases disimination against the higher frequency odulation components, particularly om stations at the low frequency end the band. However, most country teners are glad enough to accept some striction in high frequency response, it yields a signal which is separated ore cleanly from extraneous noise and terference.

Mechanically, the new tuner is similar the earlier Playmaster 111 Program urce. It uses a chassis and panel of e same overall shape and dimensions d the same dial kit and front escuteon. It will fit into the same metal x, measuring 12¾ x 7 x 4⅝ inches. lternatively, it can be housed in a oden case, as pictured.

The actual layout of the components fers somewhat, because of the need to ovide for a three-gang capacitor, the amplifier valve and the associated ils and trimmer capacitors. This has shed the IF components closer together, but room has been preserved r a separate power supply and the istle filter stage, should these be reired by individual constructors. More out these items a little later.

In looking into the design of the er, our first set-back was to discover a gree of uncertainty about the supply complete sets of coils and IF transrmers. This would have been unnkable a few years ago, but, in the erim, activity in this aspect of home nstruction has diminished and the sition complicated by transistorised cuits, which require their own particu- tuning components.

Fortunately, at just the right time, the Aegis Manufacturing Company came to light with suitable coils and IF transformers, thus providing one assured source of supply. Since then, at least one other manufacturer has expressed interest in the project while, of course, some dealers may have stocks from other sources.

But, irrespective of brand or source, you will need a set of small coils — aerial, RF and oscillator — and a pair of IF transformers suitable for use with the valve line-up shown. Components intended for transistor circuits are quite unsuitable as also are coils and IF transformers designed for "battery" valves.

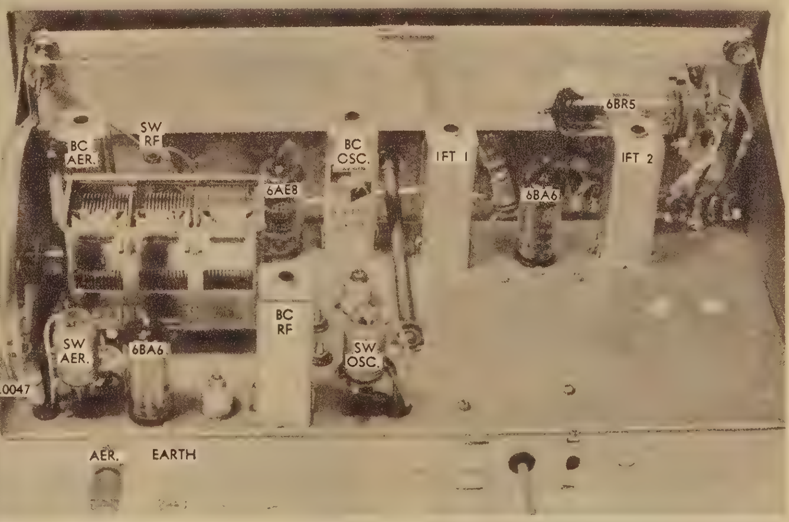
When we examined the short-wave option, the position looked even more discouraging, at first, with dealers offering an odd assortment of coils, which had collected on their shelves — but with not an RF coil among them!

Again the Aegis Company came to the rescue with a newly designed kit of "valve type" short-wave coils intended to cover the major HF broadcast bands, within the limits 5.95 to 17.9MHz, with some overlap. Other manufacturers may well "come to the party" in due course!

Next came the matter of the wavechange switch. The usual rotary type is particularly unsuitable for a chassis of the shape and size involved in this tuner and we strongly favoured the use of a slide switch, as in the 111, but with extra contacts for the RF stage.

As far as we could ascertain, larger versions of the original slide switch are not available conveniently from the manufacturers but, fortunately, we discovered that Messrs National Radio Supplies still had good stocks, presumably from an ex-disposals source. Other sources of supply may eventuate but, in the meantime, if you have any ideas about adding the short-wave facility, make sure first to get the switch.

The crank mechanism to operate it



The prototype tuner, with the short-wave coils and tuning indicator in position. The power supply, if required, would occupy the position to the right and the whistle filter the remaining space on the chassis.

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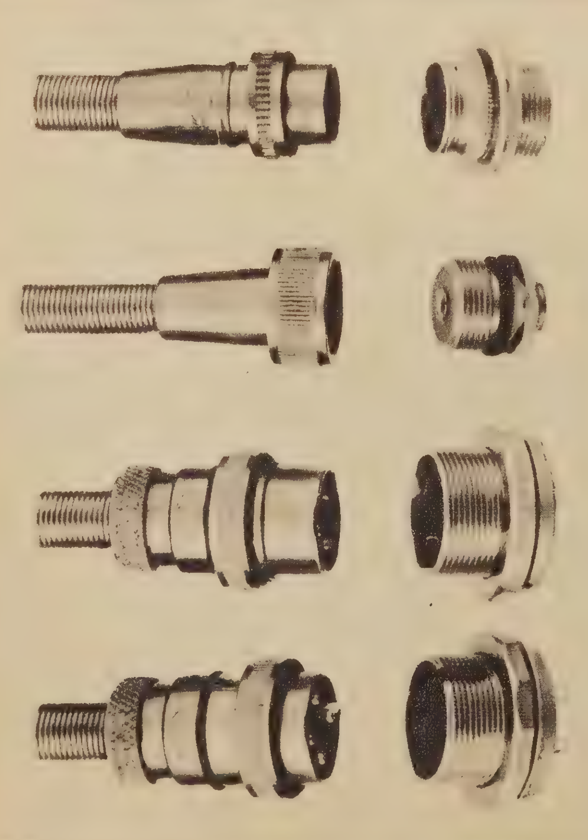

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to be made up from scrap metal, this is no great problem.

The circuit, incidentally, has been wn with the switch contacts in the adcast band position. If it is intend- to construct a "broadcast only" ver- n of the tuner, simply wire the cir- ts through, ignoring the switch sym- s.

As far as the circuit is concerned, it lows for the most part along the lines the 111 Program Source already men- ned, but there are essential differ- es.

One is the inclusion of a separate C diode, operating in a higher im- lance circuit than we would have been pared to use for the detector. This arate AGC system proved to be essen- l to limit the very high gain of the w tuner, in the presence of a strong nal—a local regional, for example — eived on a long aerial.

Our concern with effective AGC ac- n is also apparent in the RF stage, ere a divider network is used to ply the screen and to limit screen tage swing with AGC applied to the d.

The case for switching out the second transformer is less strong in a tuner e this, because of the extra selectivity posed by the RF amplifier stage and "DX" conditions under which the ner is likely to be used. However, ce the escutcheon provides for the ntrol and little extra circuitry is in- lved, we have retained the selectivity itch. There may be occasions, even short-wave, where the lowered selec- ity may be useful.

Coming now to the actual construc- n, the coded photographs show the neral layout and location of major mponents.

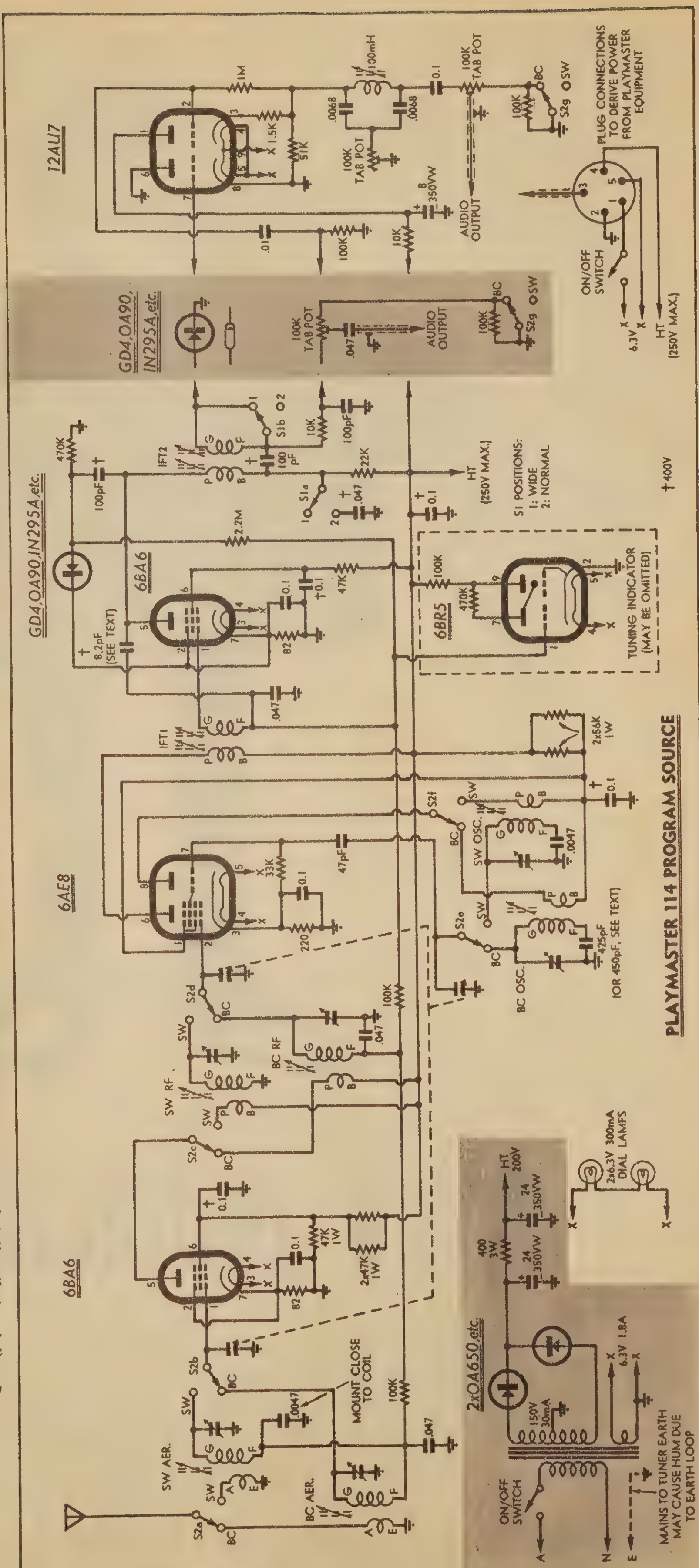
Those wishing to do their own metal- rk will be able to obtain a chassis ueprint through our Information Ser- e for 50c. However, most will prefer buy a pre-punched chassis and panel, ich should be available through ad- rtisers in due course. Check it first in ation to the various components and ake any modifications which might be cessary.

The logical place to commence con- ruction is with the dial and tuning echanism.

The dial glass rests hard against the ar of the front panel in a space pro- ded by cut-outs in the bent-round chas- ends. Assemble the chassis to the nel and check that the glass fits into e available space. If too tight, dis- semble and file the metal as necessary. lso check the vertical positioning of the ass. If too low, pack it up with a iver of card, or similar material, mented against the bottom of the slot.

Small clips held under assembly nuts each end of the glass hold it in place. careful how much pressure the clips ert on the glass, as too much will use it to crack.

Prior to fastening the three-gang tun- g capacitor to the chassis, attach the


12AU7
1M
100mH
0.1
100K TAB POT
.0068
.0068
1.5K
51K
100K TAB POT
8 350VW
AUDIO OUTPUT
100K
BC
S2g
OSW
PLUG CONNECTIONS TO DERIVE POWER FROM PLAYMASTER EQUIPMENT
.01
100K
10K
ON/OFF SWITCH
6.3V
HT (250V MAX.)
GD4,OA90, IN295A,etc.
100K TAB POT
.047
AUDIO OUTPUT
470K
100pF
IFT2
S1b
10K
100pF
22K
S1a
.047
0.1
HT (250V MAX.)
S1 POSITIONS: 1: WIDE 2: NORMAL
400V
GD4,OA90,IN295A,etc.
2.2M
6BA6
8.2pF (SEE TEXT)
0.1
47K
82
100K
470K
6BR5
TUNING INDICATOR (MAY BE OMITTED)
.047
IFT1
2x56K 1W
S2f
SW
SW OSC.
.0047
6AE8
33K
47pF
220
S2e
BC OSC.
425pF (OR 450pF, SEE TEXT)
S2d
BC RF
.047
100K
SW RF
S2c
HT 200V
24 350VW
400 3W
2x6.3V 300mA DIAL LAMPS
6BA6
47K 1W
2x47K 1W
2xOA650,etc.
6.3V 1.8A
S2b
MOUNT CLOSE TO COIL
.0047
100K
.047
150V 30mA
SW AER.
BC AER.
S2a
ON/OFF SWITCH
MAINS TO TUNER EARTH MAY CAUSE HUM DUE TO EARTH LOOP
A
N
E

PLAYMASTER 114 PROGRAM SOURCE

At right is the composite circuit. The prototype tuner was wired with the simple detector circuit (shaded) but this could be replaced in special cases by the combined detector, audio output and filter, involving the extra 12AU7. Also shown shaded is the optional power supply.

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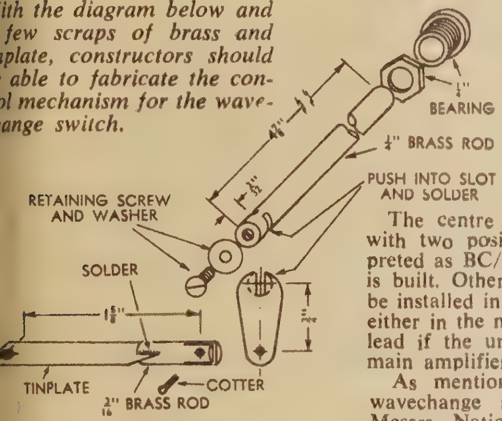
essary leads to the stator plates. The drum should also be fitted to the g before mounting. A bit of tinker- may be necessary to properly posi- the drum on the shaft so that it be rotated without scraping the sides the cut-out. The normal brackets used to mount the gang in conjunc- with four ½in spacers and ⅜in ws.

he dial backing plate, which also acts a guide for the pointer, can now be d. If the tuning indicator is to be uded, the bracket and 9-pin socket uld be attached before mounting the e. Two ⅜in spacers separate the back e from the front panel, providing n for the pointer between them. king from the rear, the left-hand bolt ¾in long and the right-hand one 1in , both having countersunk heads.

ith the diagram below and few scraps of brass and plate, constructors should able to fabricate the con- ol mechanism for the wave- ange switch.



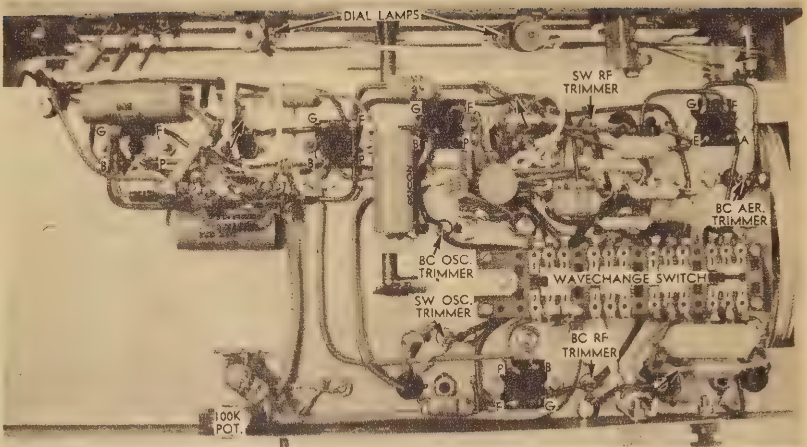
o sets of bushes and pulleys are re- ed on the left-hand bolt, while only is needed on the right-hand side. fourth pulley is mounted on the om left-hand 1in long assembly w, while a fifth is attached to the flange of the chassis. If drums and eys are aligned correctly, the ¼in n used in the fifth pulley will allow cord to move along the outer edge he drum, preventing the cords from bing.

he dial mechanism may now be ng, using, for preference, proper ven nylon dial cord. The pointer is ced on its guide and one turn of cord aken around it, with three turns und the knob spindle. A stringing gram usually accompanies the dial but, in any case, a photograph of arrangement has appeared in several issues, the last being October, 1965.

nsure that the spring is correctly ten- ing the cord and that the whole sys- works smoothly. A small drop of on the pulleys will help, but keep it y from the cord. Obviously enough, dial system can be adjusted easily at early stage, but not so later.

s can be seen, two standard dial lamp ders were bolted against the inner side he front panel, underneath the dial e. The lamps have been wired in es, since it is unlikely that their full liance will be required and their life, 3 volts across them, should be very indeed.

ll bolts passing through the panel uld have countersunk heads and uld be kept flush with the surface. escutcheon used on our prototype, ch is identical to that devised for the

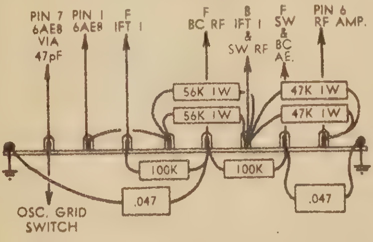


Beneath the chassis, most of the wiring leads to or from the wavechange switch and the two component tagstrips, which can be pre-wired to the diagrams shown below.

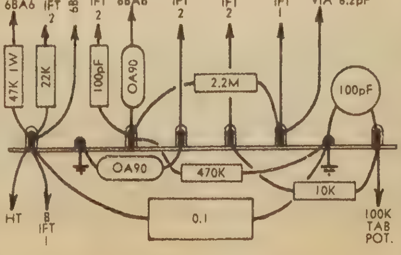
111 unit, may be supplied as part of the kit, or may be obtained separately from advertisers.

The centre control is simply marked with two positions which can be interpreted as BC/SW if a dual-wave version is built. Otherwise an off-on switch can be installed in the vacant hole and wired either in the mains lead or in one heater lead if the unit is to operate from the main amplifier supply.

As mentioned earlier, the slide-type wavechange switch was bought from Messrs National Radio Supplies, 332 Parramatta Rd., Stanmore, N.S.W. It is a 10-pole 2-position unit and, with two poles trimmed off neatly, it was mounted beneath the tuning capacitor, using four ½-inch pillars and ⅛-inch bolts. This type of switch, mounted as indicated, allows for systematic wiring of the individual stages and minimises the risk of instability.



Above, the tagstrip supporting components to do with the RF, converter and IF valves, mounted adjacent to the wavechange switch. Below, the second tagstrips supporting components to do with the IF amplifier and detector. For full constructional data and a wiring diagram of the whistle filter stage and power supply, see the article describing the "Playmaster 111 Program Source" commencing on page 39 of the November, 1965, edition.



There remains, of course, the problem of operating the slide switch from a knob on the front panel. Individual constructors may have their own ideas on how to achieve this, but the system shown in the diagram is well within the capacity of the average hobbyist, and is the one employed in the 111.

A piece of ¼-inch brass rod passes through a suitable bearing, or neat fitting ¼-inch hole, in the front panel. At the other end, the rod runs in a bearing provided by a ¼-inch hole in a flap turned up from the main section of the chassis.

The rod is retained very simply by drilling and tapping for a ⅛-inch Whitworth screw and providing an oversize washer.

The drop-arm can be made from a scrap of brass. A slot is cut, as shown, so that it will slip into two shallow sawcuts on the ¼-inch rod, leaving just enough rod behind the sawcuts to run in the rear bearing. The drop-arm is sweated to the ¼-inch shaft on the front side only, and clear of the rear bearing surface.

The drive to the switch slider can be made from scraps of 3/16th-inch brass rod and tin plate. The length should be such that the drop-arm is vertical when the switch is halfway between the BC and SW positions.

A small cotter is required to pin the drop-arm to the switch drive, or a brass tack with a spot of solder on the end to retain it in position. The arm is attached to the slider switch by drilling a ⅛-inch hole, fitting it to the drive point and retaining it with a piece of paper clip, or similar material, wound around to form a clip.

As the photograph reveals, the short wave coils are mounted differently from the broadcast and IF coils, being designed for push-fit mounting into 5/16-inch holes and connected in circuit with flying leads. The BC coils and IF transformers fit over 11/16-inch punched squares and are held in position by bolts attached to the can. Other brands

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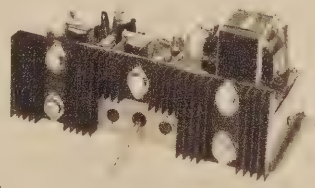
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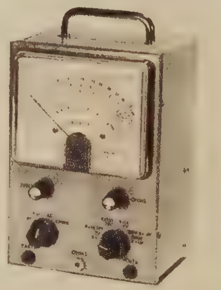
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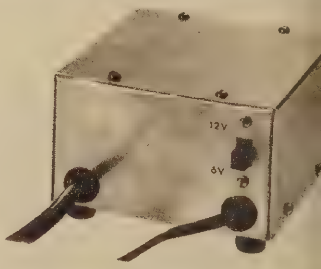

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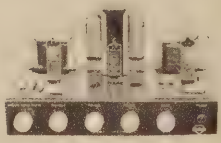
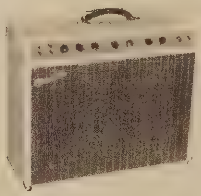

Mullard Stereo 3.3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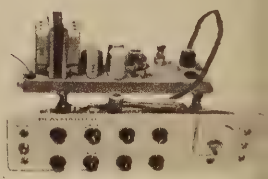
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1 Chassis 12in x 6in x 1¼in.
1 Front Panel, 12¼in x 4⅝in.
1 Case to suit (optional).
1 3-Gang, 415pF, tuning cap. (Roblan or similar).
1 Miniature B'cast aer. coil.
1 Miniature B'cast RF coil.
1 Miniature B'cast osc. coil.
1 SW aer. coil (DW version only).
1 SW RF coil (DW version only).
1 SW osc. coil (DW version only).
2 Min. 455KHz IF trans.
3 5-30pF Philips trimmer cap. (6 for DW version).
2 9-pin min. valve sockets.
2 7-pin min. valve sockets.
1 100K tab pot.
1 8-pole 2-position slider switch and 4 only ½in x ⅛in mounting pillars (DW version only).
1 2-pole 2-position rotary switch.

RESISTORS

2 82 ohm ½ watt.
1 220 ohm ½ watt.
1 10K ½ watt.
1 22K 1 watt.
1 33K ½ watt.
3 47K 1 watt.
1 47K ½ watt.
2 56K 1 watt.
4 100K ½ watt.
2 470K ½ watt.
1 2.2M ½ watt.

CAPACITORS

1 8.2pF ceramic (see text).
1 47pF ceramic.
3 100pF ceramic.
1 425 or 450pF 5% mica padder (see text).
1 .0047uF 5% 100V styro padder. (DW version only).
1 .0047uF 100V polyester.
4 .047uF 100V polyester.
1 .047uF 400V polyester.
3 0.1uF 100V polyester.
4 0.1uF 400V polyester.

VALVES, DIODES

1 6AE8.
2 6BA6.
1 6BR5 tuning indicator.
2 OA90 germanium diodes (or similar).

DIAL PARTS

1 Dial drum 3⅞in diameter, with ¼in spindle hole.
1 Dial glass to suit drum (6¼in span), 10in x 1¾in overall.
1 ¼in dial spindle, 4ft nylon cord, spring and pointer.
5 Pulleys, 6 only ⅜in long bushes, 1 only ¼in long bush. Metal for back plate (11½in x 2in), and two clamps for glass (¾in x ½in). Countersunk head metal thread screws of ⅛in diameter—½, ¾, 1, 1¼in long. Wave change switch metal-work as per diagram.

POWER SUPPLY

1 Transformer, 150V at 30mA and 6.3V at 1.8A.
2 Silicon diodes, type OA650 or similar.
2 24uF 350VW electro cap.
1 400 ohm 3-watt resistor.
2 8-lug tagstrips.
3 Rubber grommets.
1 Length of 3-core power flex and 3-pin mains plug.

WHISTLE FILTER

1 Whistle Filter Coil (approx. 100mH).
1 12AU7 valve.
1 9-pin min. valve socket.
1 100K tab pot.
1 8uF 350VW electro cap.
1 0.1uF 350V paper capacitor.
1 0.01uF 200V paper capacitor.
2 0.0056 or 0.0068uF 200V paper capacitors
1 1M ½ watt resistor.
1 100K ½ watt resistor.
1 51K ½ watt resistor.
1 10K ½ watt resistor.
1 1.5K ½ watt resistor.
1 8-lug tagstrip.
N.B. If whistle filter stage is to be included the OA90 germanium diode detector in the basic version is not required.

SUNDRIES

1 5-pin plug and cover.
3 Knobs.
1 2-lug, 1 5-lug, 1 8-lug, 1 10-lug tagstrip, length of coaxial cable, aerial and earth terminals, 2 x 6.3v 0.3A dial lamps and holders, solder, solder lugs, hook-up wire, rubber grommets, nuts, bolts and washers.

---

come fitted with spade lugs, which meant to bend over beneath the is and be soldered in place.

fore mounting the broadcast or IF take careful note of their connec- for correct orientation. This es also to the valve sockets.

elected to use Philips trimmers this tuner and to solder them tly into position. This made it sary for us to build our prototype a passivated steel chassis, rather on aluminium. However, once ated, the trimmers are mechani- firm and convenient and very e electrically.

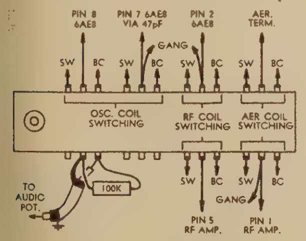
ree holes are necessary in the is to mount each trimmer. The holes should accommodate the two lugs, which are attached to the hy" body of the trimmer. The are simply bent over and soldered e chassis. The centre lug, passing gh the chassis is the active connec- which associates with the "grid" of its respective coil.

wire the switch and coils, it will ecessary to follow the circuit dia- carefully, along with connection for the particular coils used. Note our circuit has been drawn with wave change switch in the "broad- position.

r the guidance of constructors, we sketched the sequence of contacts e switch. Six of the eight poles are for coil switching, while a seventh duces an extra resistor in series the earth return of the audio out- pot. This allows a larger proportion e audio signal to reach the ampli- effectively increasing the gain on waves. A suggested value for the tor is 100K.

e rest of the construction is ghtforward, most of the capacitors, tors and diodes being accommoda- on a 10-lug tagstrip between the r and wavechange switch and an 8- tagstrip alongside the IF amplifier. diagrams.)

e output is taken via a .047uF citor on a 2-lug tagstrip towards the of the chassis, and a 100K tab mounted on the rear lip. This ws the output level to be set so the tuner only delivers as much l as the audio system can accept eniently, and/or, without distor-



uggested connections for the avechange switch. The blank ction could possibly be used for dial lamp switching.

upply leads and the 100K resistor the tuning indicator are taken via a g tagstrip on top of the chassis at front right-hand edge.

ost constructors will probably elect operate the tuner from the power ly of a main amplifier. With this ind, the circuit as drawn shows the ly leads wired to a five-pin plug, esponding to the socket on the rear of Playmaster control units. With some earlier Playmasters, or in commercial amplifiers, it may be necessary to rearrange the connecting leads and to provide a suitable high-tension feed circuit.

Typically, the tuner may be operated with up to 250 volts high tension. Measured under "no-signal" conditions, the current drain may run to between 25 and 30 mA; with signal it will fall to about 13mA. Where necessary, the tuner will operate quite well on lower voltages, with a proportionate saving in current drain.

As far as the amplifier is concerned, it is best to feed the tuner from the main high tension line, since this is least likely to affect the supply to the preamplifier, etc. Depending on the source voltage and the figure at which it is desired to operate the tuner, a dropping resistor of between 1000 and 2000 ohms, rated at say five watts, would typically be required. The resistor may or may not need to be bypassed at the tuner end with an electrolytic capacitor, depending on whether there is any tendency to hum or audio instability.

Special note should be taken of the heater circuit. If the heater supply is connected to chassis in the main amplifier or control unit, the wiring in the tuner should be kept free from chassis.

If the heater wiring is not otherwise grounded, it should be connected to chassis within the tuner. It is usually sufficient in this case to ground one side.

In the event of there not being a suitable high tension supply available, it is possible to include a power supply in this tuner. As detailed in the October, 1965, issue for the 111, it would occupy the area bounded by the outer edge of the chassis, the 100K tab pot, and the two holes near the 8-lug IF tagstrip.

The power transformer bolts to the top of the chassis, with the primary and secondary leads taken through the two larger holes to the underside where there are two 8-lug tagstrips on which are soldered the associated components and connections.

The hole through which the mains cord passes can be seen to the right of the audio output pot, in the rear view photograph. This, and the holes through which the transformer primary and sec-

(Continued on Page 149)

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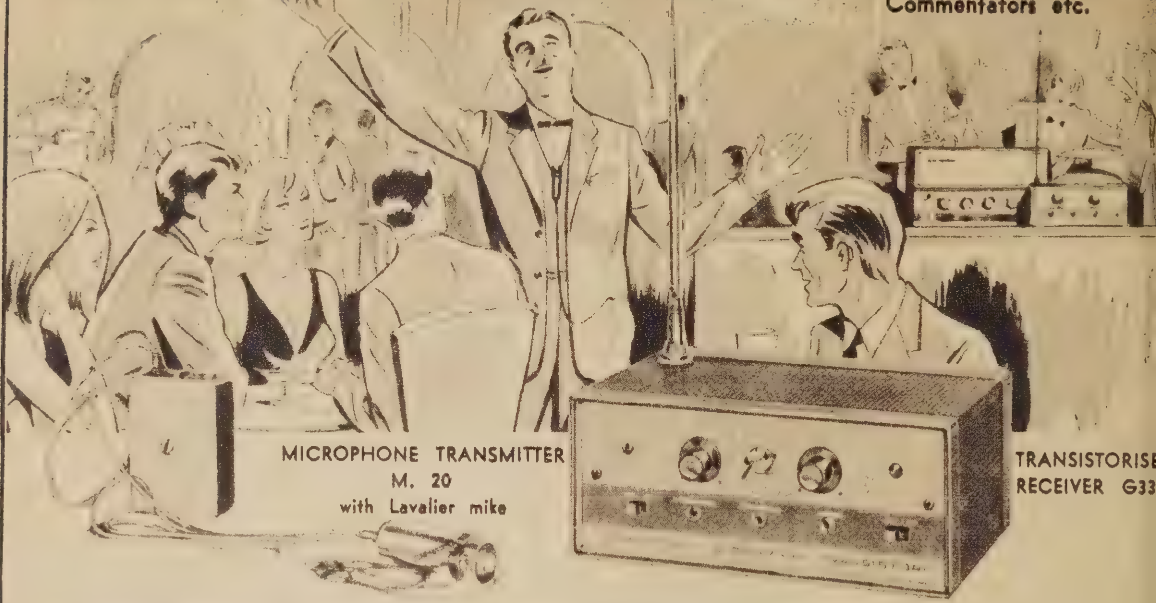

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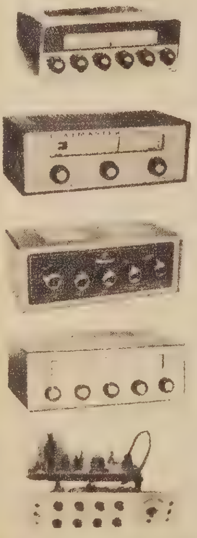

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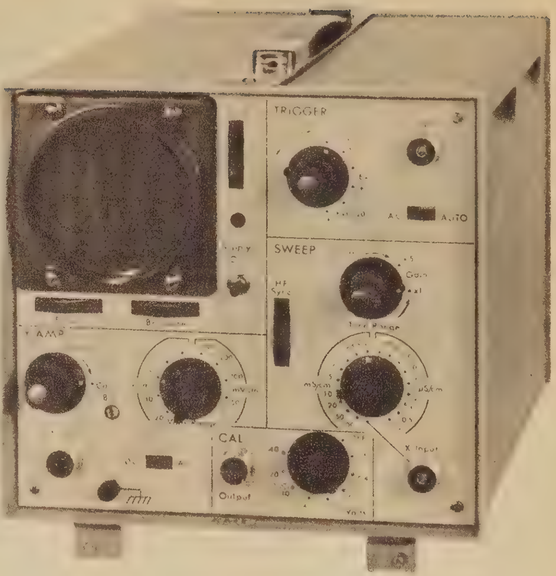
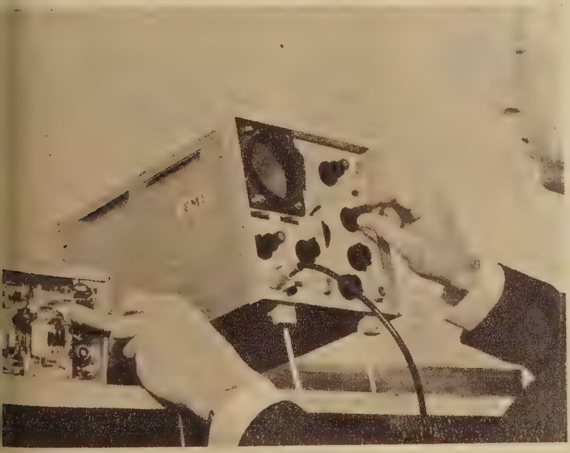


Although transistors present the cathode-ray oscilloscope designer with more problems than valves, they also confer many advantages to the final design — the more notable being higher realiability, reduced weight and size and cooler operation. This article describes a new low-cost transistorised C.R.O. produced by E.M.I. Electronics in conjunction with Marconi Instruments.

by M.W.G. Hall, A.M.I.E.R.E.*

[he oscilloscope is now possibly the st common piece of electronic test iipment. To those engaged in ctrical or electronic engineering and those applying these techniques, it ; become almost a link between the iin of the user and the circuit under t. Could this be because we all find "easier to read the pictures than the rds?"

Certainly one can examine, for imple, the output waveform of an cillator and with an oscilloscope asure frequency, amplitude, distorn, phase, etc., and in the case of nonusoidal waveforms such other parateters as mark/space ratio, overshoot, , etc. To perform these measurements other means could involve racks full counters, voltmeters, wave analysers d other complex instruments, vastly ore expensive although probably giving eatly increased accuracy.



The new instrument in use in a developement laboratory. Being transistorised, it may also be operated from batteries in remote locations.

A look at the way in which oscilloope development has progressed over e past ten years reveals a steady inease in Y amplifier band-width, trigger rformance and facilities, cathode ray be writing speed and voltage and time easurement accuracy. Inevitably, prices r "state of the art" instruments have so risen from a few hundred dollars over two thousand dollars for the ghest grade of instrument.

The development of these newer techniques is now, however, being reflected in the design of low priced, less sophisticated instruments, which show great improvements over those hitherto available. Such an instrument is the Marconi Instruments TF 2203/E.M.I. Electronics 101, which is a small, compact and highly portable instrument, especially useful where space or power consumption is at a premium.

This instrument, which complements both the Marconi Instruments and the E.M.I. Electronics ranges of measuring oscilloscope, was designed by E.M.I. Electronics Ltd., and is manufactured by them under special conditions which offer the customer maximum cost saving. It is fully transistorised except for the Y amplifier input cathode-follower, and hence possesses most of the attributes conferred by the use of solid state construction.

The signal to be examined is fed, either AC or DC coupled, into a frequency compensated attenuator, and from thence to the input cathode-follower. The circuit following the input cathode-follower consists of two main stages.

The first is a long tailed pair which acts as a phase splitter and employs degenerative feed-back across part of the emitter circuit, to provide pre-set and continuously adjustable gain. The residual resistance of the variable Y gain potentiometer is removed by a micro-switch which "makes" when the control is set to the calibrated position.

Centring and Shift voltages are fed into the base of one transistor, via an emitter follower, while the output of the cathode-follower feeds into the second transistor.

This first stage employs PNP transistors, and is followed by an output paraphase amplifier using NPN transistors. The final balanced output signal is applied to the cathode ray tube Y plates.

Trigger pulses may be derived either from the Y amplifier output or applied to an external trigger input socket where the applied signal may be either used directly or attenuated by a factor of 20:1 as desired. The selected trigger signal is passed via two cascaded emitter follower to a level selecting circuit consisting of two diodes.

The current fed to the diodes is adjusted by means of the Trigger Level (or Set Auto-Level Pre-set) control such that one or other diode conducts depending upon the polarity of the applied signal. The signal is thus clamped to earth until its amplitude is sufficient to back bias the hitherto conducting diode and to forward-bias the second diode.

When this changeover occurs a voltage step is produced which is then applied to a two-stage transistor amplifier which either acts as a simple inverter or as a long-tailed pair, depending upon the setting of the trigger signal polarity switch. The output is taken from the same collector in either event, thus always providing a positive going output which causes a following NPN transistor to conduct.

The final output trigger pulse is derived from a **tunnel diode** which is reversed biased when the NPN stage is cut off and forward biased when the transistor conducts. As the forward current through the tunnel diode increases a point is reached where the well-known discontinuity occurs, producing an extremely sharp negative going voltage transition.

This voltage step is fed to an amplifier

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ge from whence the output passes via emitter follower to the Time Base cuit.

When the Trigger Mode switch is set "Auto," the first transistor of the plifier and the tunnel diode combine a free-running multivibrator. The freency is controlled by means of capacis associated with the Time Base range itch so that time base sweeps occur at epetition rate of approximately 10KHz the six fastest ranges, at 200Hz on next six, and some 5Hz on the six west ranges. This facility assists in intaining constant display brightness.

The trigger pulse is applied to one ut of a bistable circuit. The voltage el of one of the bistable transistor llectors is used to control the moduor electrode of the cathode ray tube amplifier stage, so ensuring that beam rrent is turned off during the fly-back d hold-off sequence.

The sweep generator is a boot-strap cuit in which the saw-tooth waveform produced by the constant current arging of the selected RC timing cir-it.

The eighteen time base ranges are rived by the combination of six capacis and three resistors.

With the operation of the input bistle circuit (which is initiated by the apication of a trigger pulse) a clamp is noved from the ramp generator initiatg the run-down coincident with the tion of turning on the cathode ray be beam current. Thus the trace apars on the screen face and executes a rward stroke. When the saw-tooth volte acquires a certain value, a monoble circuit is energised, reversing the ndition of the input bistable and so opping the forward stroke.

This action cuts off the cathode ray be beam current and, by re-imposing clamp on the boot-strap circuit, the ning capacitor is rapidly discharged, using the flyback action.

To prevent following trigger pulses om initiating further reverses of the put bistable state before the timing pacitor has fully discharged and all cuits have reached equilibrium, it is ranged that for the period of the monoble output further trigger pulse action inhibited.

The period of the monostable output determined by the switching-in of pacitors appropriate to each time base nge. Further control of the output riod is exercised by the HF Sync. tentiometer, which improves synchrosation at frequencies above 5 MHz or).

The output saw-tooth waveform is upled to the X amplifier via a DC vel shifting zener diode into the base one of the two transistors which, ranged as a long-tailed pair, provide e paraphase outputs to drive the thode ray tube X-plates.

Degenerative feed-back in the emitter rcuits provides control of X gain, a riable potentiometer providing trace pansion up to X5. Pre-set potentiometers enable trace length to be set curately on both the X1 and X5 expansion settings. The "tail" of the longiled pair is formed by a transistor perated in a constant current mode, so proving the amplifier in-phase jection.

When the Time Range switch is set to X Input," the Time Base output is disnnected and the amplifier is connected the front panel "X In" socket. At ther settings of the range switch the Time Base saw-tooth voltage is available from this same socket for external use.

The power supply circuit provides ten separate supplies, all of which are derived from a basic 12 volt supply via the medium of a DC to DC converter. The basic 12 volt supply may be provided either from external batteries, from an internal rechargeable DEAC battery, or from the AC supply mains through an unstabilised full wave rectifier circuit.

The oscillator section of the DC to DC converter operates at approximately 7KHz. The level of oscillation is regulated by means of a circuit referenced to a zener diode, so compensating for changes caused by fluctuations of mains supply voltage or output line loading.

This type of power supply circuit has two distinct advantages, the first and most obvious being the ability to operate on battery supplies. The second is the capability of accepting AC supplies of widely varying voltage without recourse to transformer tap-changing.

To assist in checking the performance of the Y amplifier and attenuator a voltage calibrator is provided which consists of a transistor switch driven at the power supply oscillator frequency and arranged to "chop" a current drawn from one of the stabilised lines. The resultant squarewave voltage is made available at a front panel socket and is controllable in amplitude in eight switched steps.

It may be seen that by virtue of its lightweight compact mechanical design and low power consumption, together with its electrical specification, the instrument is well suited for a large number of measurements and observations. Similarly, it is highly suitable for educational and demonstration use.

BRIEF SPECIFICATION

Y AMPLIFIER

Calibrated Sensitivities: 50mV—20V/cM in 9 compensated ranges, with 1:2:5 range ratios. A fine gain control allows a further 3:1 range of continuous adjustment.

Input Impedance: 1M in parallel with 28pF, all ranges.

Bandwidth: DC or 3Hz to 15MHz (—3dB). **Risetime:** 23 nanoseconds.

Overshoot and Ringing: Less than 1 per cent of peak pulse amplitude.

VOLTAGE CALIBRATOR

This produces a square wave at approximately 7KHz having a risetime of less than 1uS. Eight switched amplitude levels are provided: 200mV, 400mV, 1V, 2V, 4V, 10V, 20V and 40V. The last-named level can be accurately set by reference to an external 40VDC meter; all other levels will then be accurate to within 2 per cent.

SWEEP GENERATOR and X AMPLIFIER

Bandwidth: DC to 4MHz (—3dB) at x1.

Sweep Expansion: Continuously variable from x1 to x5, both extremes calibrated.

Sweep Speeds: 200nS—100mS/cM in 18 ranges, with 1:2:5 range ratios.

Sweep Mode: Triggered, with variable flyback time for steady locking.

Linearity: 2 per cent.

TRIGGERING

Selector: Internal, external and external attenuated 20:1, either polarity in each case.

Mode: AC (adjustable trigger level) or automatic (on zero crossings).

Bandwidth: 5Hz to 15MHz. **Input Impedance:** 1M in parallel with 25pF.

CATHODE RAY TUBE

Type: EMI type MX54 3-inch diameter flat screen.

Display Area: 5cM x 6cM. **EHT:** Approx. 2.6KV.

Modulation: External 50V peak signal gives full brightness modulation.

ELECTRICAL

Power Supplies: 97-132V or 195-265V (absolute), 50-60Hz, or 12V DC (11-14V absolute), positive earth, internal or external.

Power Consumption: 25W on AC, 20W on DC.

PHYSICAL

Dimensions: 9in x 8½in x 15in. **Weight:** Approx. 17lb.

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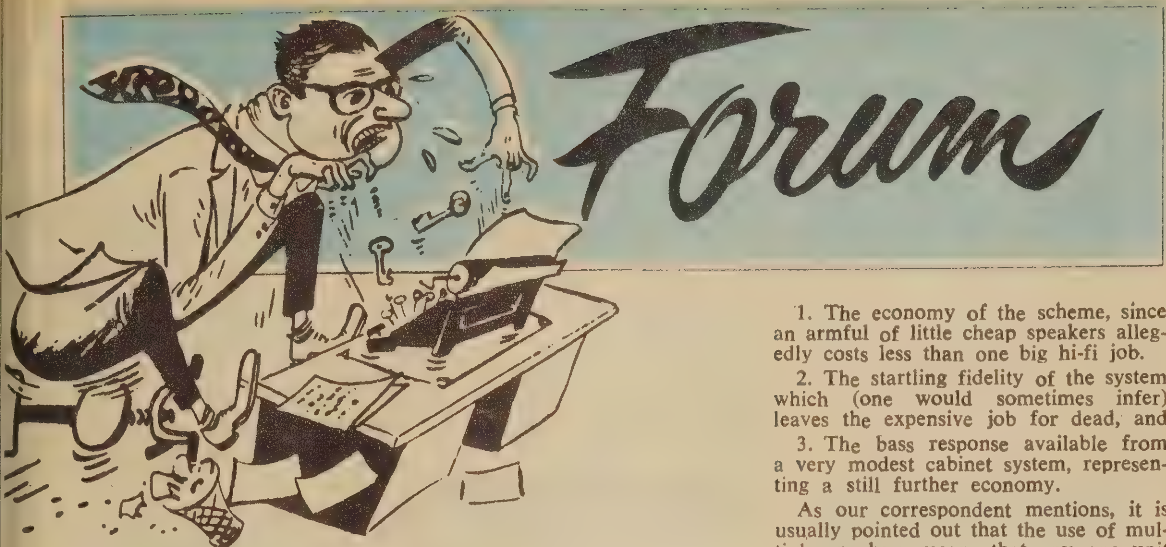

OPERATING SPEAKERS IN PARALLEL

After the seeming pre-occupation with AM, FM and SSB, along with medical gadgets and science fiction, it is a change to get back, even if briefly, to good old audio.

By W. N. Williams

› hand is a letter from a reader in , Victoria, extolling the virtues of :iple loudspeaker systems. He says:

Multiple speaker setups for hi-fi have n been described to me in glowing ıs, by friends and in magazine :les.

mong the claimed qualities, which › longer doubt, are (1) very low in- ıodulation distortion because of the ll distance travelled by each indi- ıal cone; (2) good transient response ıuse of the small mass of each cone :pared with that of a larger speaker the same power handling capacity; high power handling capacity and, but not least (4) low cost.

Interested in the advantages of such ystem, I decided that I would probe ttle further into its qualities.

Apparently the lowest frequency reduceable decreases by half each time number of speakers is doubled, viz.: peaker flat to 70Hz, 2 speakers flat 5Hz, 4 speakers to 17½Hz, and so on. vever, this is seemingly a little doubt- A disadvantage of such a system hat the amplitude of the resonance k increases.

Nevertheless, having on hand a num- of 8inch speakers, I was determined try the system.

Considering the different nature of cone resonance of the speakers (60, 70 and 120Hz), I reasoned that an ıntage might be realised through a ıdening or flattening of the reson- e peak.

I ultimately mounted the speakers in open-backed box of about 5 cu ft tent, for a rough check on what ht be expected.

"The quality was quite surprising, from a 101 amplifier and associated tone controls. Having set the bass control back several notches from where it usually points, the bass was good with only a trace of hangover, possibly from reflection inside the unpadded enclosure.

"The total cost for the speakers was only of the order of $24 to $30 including a Rola 5FX tweeter to extend the H.F. response.

"Such a cabinet can readily be polished or covered with leatherette, but remember that the panels must be at least ¾in thick to minimise resonance effects.

"Those keen to experiment may care to fit a back to the enclosure and try either lining it or packing it with absorbent material. However, I am just content to relax and contemplate the noises coming from the economy hi-fi system as it is.

"Fifteen ohm speakers can be connected in series-parallel to operate from a 15 ohm source, or in parallel to match about 4 ohms. Lower impedance speakers can be connected in series-parallel for low impedance or series for higher impedance. Check with a torch cell to see that all cones move in the same direction."

D.K. (Kew, Vic.)

To be sure, multiple loudspeaker systems have been mentioned many times in technical literature. Our correspondent suggests four 8-inch loudspeakers in a fairly conventional box, but I can recall whole arrays of 3, 4 and 5-inch speakers presented in enclosures ranging from the triangular to the neo-spherical, with many-angled claims to match.

Minus all the verbage, the emphasis is normally on:

1. The economy of the scheme, since an armful of little cheap speakers allegedly costs less than one big hi-fi job.

2. The startling fidelity of the system which (one would sometimes infer) leaves the expensive job for dead, and

3. The bass response available from a very modest cabinet system, representing a still further economy.

As our correspondent mentions, it is usually pointed out that the use of multiple speakers means that any one unit is required to handle only a small fraction of the total power, thereby ensuring small cone excursion and low resulting distortion. The increased cone area gives better coupling to the air at low frequencies, hence better bass response. The characteristics of the individual cones tend to vary, with a good chance that they will compensate for one another's peaks and troughs.

It all reads very impressively . . . but . . .

If the small speakers are so inexpensive, that from four to eight of them per channel still look like a bargain, then they are inexpensive, indeed!

The most one can expect for this kind of money are loudspeakers originally intended for small portables or mantel receivers and with the characteristics which are usually found in such speakers. These include a bass resonance placed fairly high up in the spectrum (125Hz or above), a prominent response around 2000 to 3000Hz and very little above about 5000Hz. Added to this will normally be a quite limited power handling capacity for a given order of distortion.

Operating the speakers as a group will certainly multiply the effective cone area, increase their power handling capacity and lower the distortion, as compared with any one of the speakers operating singly.

The group may or may not compare favourably in these respects with a large, high performance speaker, depending on the particular units involved. The same kind of remark would cover power sensitivity and price.

But the problem of frequency response is likely to constitute a much greater hurdle. If the small speakers individually exhibit a fundamental cone resonance at 125Hz or above, then the group will do likewise — and I can't imagine a greater barrier to true bass response than a fundamental system resonance of this order.

It would have been provided in the first place to give an illusion of bass and it will go on doing exactly that, practical enclosures nothwithstanding.

And if the small speakers also have a prominent middle response (for "presence") and restricted treble (not necessary, anyway, in a cheap AM receiver) then the group will likewise exhibit

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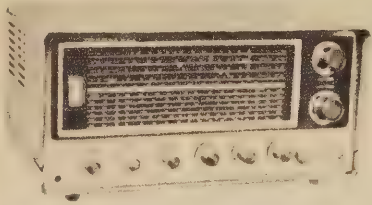

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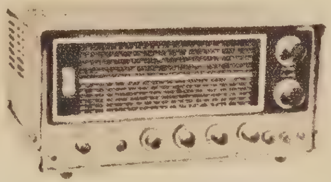

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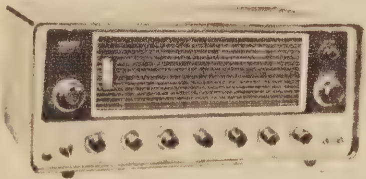

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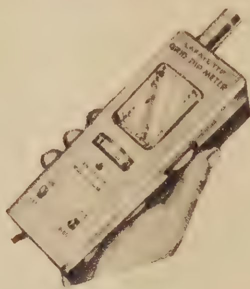

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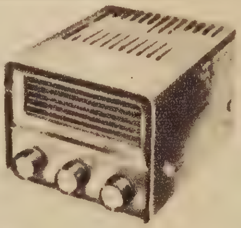

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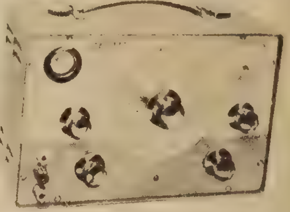

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ominent middle and restricted treble. nd this will obtain, irrespective of hether the individual speakers help to nooth one another's adjacent peaks d troughs; the broad contours of the rve will remain unaffected.

As for baffle requirements, multiple nes do not change fundamental laws.

On an open system, pressure waves om the rear will still cancel those om the front at frequencies related the distance around the baffle edges.

In a vented system, the multiple nes will approximate a single cone equivalent area and dominant resonnce — a not very attractive combinaon.

In a sealed system, each speaker will ehave as if it were in a box approxiating the enclosed volume divided by e number of speakers, and this may ush its resonance up still further.

In short, parallel operation allows nall speakers to do a big job but, as r as frequency response is concerned, ey can offer nothing collectively that ey do not possess singly. The observaon earlier about bass cut-off halving as e number of speakers is doubled is a isleading half-truth, as our corresponent already suspects.

But the remark about better transients ecause of lighter cones is also heavily uspect. Transient response and high requency response are first cousins and high frequency response is poor usually because of compliance at the one apex) then the transient response ill likewise be poor.

But what if the speakers are delibertely dissimilar? Wouldn't this spread eaks and troughs and even things out?

Only to a very limited extent. Small, heap speakers, made for portable and nantel receivers tend to exhibit the kind f response we have already mentioned, rrespective of make. Selecting different oudspeakers within this category is not ikely, therefore, to secure a markedly etter response contour.

Then what about groups of small, ide-range speakers?

That's a very different matter. We ere most impressed by the quality of ound available from the .Magnavox WR, backed up by a tweeter, in our ookshelf loudspeaker system. Equivaent imported loudspeakers also sounded ery good.

There is every reason to believe that wo or more such speaker combinations unctioning in parallel, would sound ven more impressive, by reason of ower distortion at a given level or igher level for the same distortion. It might seriously be suggested that they would sound marginally better than a ingle speaker of equivalent cone area because of lower cone break-up.

In fact, high fidelity systems are curently being offered by overseas manufacturers, using multiple small speakers operating in parallel, and enclosures scaled up to allow for the increased piston area.

But . . . these systems are a far cry from a collection of inexpensive little speakers. They are good speakers to start with — and normally quite expensive.

Then what about our correspondent with his four eight-inch speakers?

This is a different matter again from the cases thus far mentioned. Eight-inch speakers as a class are normally a lot better than the three to five-inchers and one can rightly expect more from them. And, as the figures quoted by our correspondent show, they can be selected with cone resonance figures extending well down into the bass region. Additionally, he has provided a tweeter to look after the top end.

One would expect such a system to sound quite good but equally, I would expect it to have some resonant lumps over the bass region and not too much output low down, where the front and back waves tend to cancel.

From the viewpoint of someone who, in the words of our correspondent had on hand " a number of eight-inch loudspeakers," it was a quite sensible thing to do with them. Even the open-backed cabinet makes sense because it allows the individual speakers to retain their natural and dispersed resonances. At most, I would suggest filling the back with light absorbent material, retained in position but not otherwise enclosed.

Any attempt to seal the enclosure or adapt it into a vented system might only emphasise the incompatibility of a large aggregate piston area, dispersed or highly placed cone resonances and a box of strictly limited dimensions.

But while we leave D.K. a happy listener (contented with what he did with what he had!), it does not mean that others should rush off and buy speakers to do likewise.

Nor does his experience with eight-inch speakers plus tweeter prove any kind of a general case, for there is none. Parallel systems can be delightful or awful, depending on the particular speakers and how they are housed — which is precisely what one could say about other kinds of speaker system.

A fan who decided to fiddle.
Made a very large system from liddle,
But, despite all his drools,
Since he'd broken the rules
He'd no treble, no bass, only middle!

PHASED ARRAYS FOR FRINGE AREA TV

Dear Sirs,

I have been re-reading your article on TV reception in fringe areas (Sept., 1965). I realise that I may be a little late with these comments, but I feel they are quite important.

One very important type of antenna seems to have been completely ignored; namely the phased array. I have lived in three fringe area towns for varying periods over the past six or seven years and think they deserve mention.

The first location was 60 miles from Adelaide TV, and line of sight from the stations. The second town was 80 miles from the stations, in the bottom of a valley and definitely not line of sight; my present location is 150 miles from Adelaide and separated from the transmitters by a peninsula and two gulfs.

My observations have been that a Yagi type of antenna is only effective in weak signal areas where all of the signal comes from ONE direction, i.e., my first residence. Where the reception is obviously by reflection, as in the case of the valley location, wider capture area is needed. It could be argued in this case that ghosting would be evident, and that this would outweigh the advantages of wide capture area, but I have found that, in this case, the reflected signal causing ghosting came from the hills to the rear of the town and was only a problem of Yagi users.

The third location is a dilly: If you can bring any antenna over here to beat a phased array, I'll pay your fares and accommodation. All of the reception here is obviously by means of scatter propagation, and here an antenna with wide capture area is a must.

There is another point in favour of the phased array; its natural impedance. TV receivers are made for 300-ohm line; a 12 element phased array has a normal 300-ohm impedance and the 16 can be matched by suitable positioning of the feeder on the phasing wires. Yagis unfortunately are low impedance devices and loss of signal seems inevitable, despite great pains taken by various manufacturers. One popular type of log-periodic simply refuses to perform in deep fringe areas unless fitted with a booster; presumably the booster output correctly matches 300-ohm line.

In conclusion, I have operated VHF ham stations from these various locations including 288MHz from the first. My observations tie in well with those made for TV.

B.W. (Cowell, S.A.)

SSB NOT NEW

Dear Sir,

Re your article under "Forum" in the July issue.

(1) I disagree with the statement that the SSB idea is "new." As a matter of fact, it's old hat, almost 50 years old. I distinctly remember reading in 1920 the patent specifications of the invention made three years earlier. It described the method, means and advantages claimed for the suppression of the upper or lower sideband frequencies at a transmitter. The inventors (two or three of them, but I now cannot recollect their names) were associated with the Cornell University, U.S.A. The patent, assigned to the Western Electric Company, probably expired some time during World War II. That it is no longer private property would partly explain the increasing popularity of the SSB type transmitter nowadays.

(2) Based on my experience at sea (from 1918 onward) of copying Press messages and handling radio traffic, I found MCW superior to CW from my viewpoint of ensuring better reception during fading periods. With MCW, it seemed that fading did not always cause simultaneous blot out of the two signalling frequencies used. If that's the case a DSB emission would be better than SSB for communication when fading occurs.

Would that provide a clue to the adverse criticism of SSB by your correspondent, in the May issue?

T.P. (Parkes, N.S.W.)

The Serviceman

ON METERS, AMPLIFIERS, & TV SETS

Why are some meters sensitive to AC superimposed on DC? What is wrong with an amplifier when it won't play and only "rumbles"? What does one look for in a TV set in which the channel selector runs amok — intermittently — for the first half hour or so of operation? These are this month's typical serviceman problems.

First off this month I should like to refer to one of my stories in the August issue. This concerned a colleague who was trapped by the unpredictable behaviour of a small Japanese multimeter in the presence of 15KHz line energy. And, in the absence of a completely satisfactory explanation, I left the matter somewhat up in the air for readers to offer any comments of their own.

Arising out of this, one reader, Mr R. E. G. of Kotara South, N.S.W., writes as follows:

"Concerning your story in the August issue about the multimeter giving strange readings when measuring DC voltages with AC superimposed. The answer is that, in the cheap meters, the AC ranges rectifier is in circuit when the range switch is set for DC volts. For example: the ——— models.

"I have met many a serviceman who has tried to read the anode voltage on the 6CK6 video amplifier valve in an H.M.V. F5 set. Starting from the HT rail and trying to read the drop across each of the four 680 ohm load resistors that are in series, one finds that the voltage reading INCREASES as one moves down the string of resistors! With a HT rail of 250 volts DC and 100 volts or so of video you get quite a surprising reading.

"Hoping that these remarks may clear up the 'mystery.'"

Well thanks R.E.G. for an interesting comment, particularly the reference to the H.M.V. receiver. Since writing last month's article I have been advised from another source that this was most likely the brand concerning which the manufacturer issued the warning about diode protected meters. So, to that extent, R.E.G. is able to support my own observations.

But in regard to his explanation of the "mystery" itself I am not so sure. I heard a similar explanation some time ago, and this was the first thing I suggested to my colleague when he told me the story. At my suggestion he checked this aspect of his meter, only to discover that, at mains frequencies at least, there was no sign of any response to typical AC voltages when applied to the DC voltage ranges. Incidentally, his meter was not of the same brand as that quoted by R.E.G.

Which seems to throw the explanation back on to the diode protection system, at least as far as this brand of meter is concerned. I have no doubt that R.E.G. is correct in regard to the brand of meter he quotes, but this only makes the situation more complex as far as the poor unsuspecting beginner is concerned.

My first story this month is only a short one, and does not involve any very profound technical discussion, but it does illustrate the strange way some people describe symptoms and how easy it is for misunderstandings to occur.

The customer in this case was a young fellow who was apparently making his first attempt at amplifier construction — and who was endowed with more enthusiasm than technical background. I first became aware of his activities when he purchased a few minor components for the project and asked my advice on a few simple points.

I gave him what advice I could, then more or less forgot about the matter until he turned up again some time later to announce that he had finished the amplifier, but coudn't make it work. Could I help? Then, as if to help persuade me, he produced a couple of rather battered circuit diagrams which turned out to be those of the R. TV and H. Twin 10W Amplifier (December, 1959) and the Control Unit No. 10 (May, 1960)—neither of which, I might add, being specifically designed for a beginner's first effort.

I pointed out that it is difficult to diagnose faults by proxy, but offered to give him what advice I could if he described the symptoms. As it turned out, he had two main complaints; the system made a "funny rumbling noise" for a few seconds after it was first switched on, and he had been unable to get any signals through it from the pickup.

My first reaction was that the "rumbling" sound was a form of motor-boating, probably indicative of reversed feedback connections. The fact that, according to the owner, it lasted only a few seconds was not inconsistent with previous experience in such matters. Depending on the amount of feedback, the output transformer characteristics and similar factors, such a condition can produce audible instability during the warm-up period, which changes to supersonic instability after a few seconds.

As for the failure to function, I considered it most likely that this was a completely separate fault but, in any case, it seemed logical to try to fix tl
instability first.

To this end, I went to some troub
to explain to the customer the gener
nature of the feedback circuit, the di
ference between positive and negati
feedback, and how this was a functic
of the feedback line connection to tl
voice coil terminals. I finished off t
suggesting that he try reversing this co
nection. He went off, promising to c
so.

A few hours later he was back, a
companied by an offsider. Between tl
two of them they carried the amplifi
and control unit, which they dumpe
on the counter. And in answer to m
question, he replied that he had trie
the changes I had suggested, but th
this had made no difference; the thir
still "rumbled." I rather gathered fro
his tone and general attitude, that h
had reached the end of his patience.
I couldn't fix it, then he would wri
it off.

Since I was rather busy right the
I told him I would try to have a loo
at it the following day. However,
was curious to know why the chang
to the feedback connections had n
made any difference—one way or th
other—and asked him to show m
exactly what he had done. I suppos
I should have known better because
have been caught the same way befor
but it came as a bit of a shock whe
he pointed out the wires he had shifte
and I realised that, in spite of all m
explanations, he had simply swappe
over the voice coil leads, while leav
ing the feedback connection to th
transformer exactly as it was before.

So that was that much effort dow
the drain.

My next shock came the followin
day, when I put the thing on the benc
and turned it over. The underside wa
the most untidy example of wiring
had seen for a long time. It was wire
with conventional plastic-covered hook
up wire, including all the earth wire
and each lead was several inches longe
than it needed to be. This, plus th
fact that the same coloured wire ha
been used throughout, resulted in th
most confusing tangle of wires imagin
able. I mentally registered that, if th
trouble involved anything but the mos
elementary fault, it would be going bac
to the owner for a rewire before
tackled it.

Nevertheless, I decided to at leas
switch it on and see what happene
When I did, it began to motorboa
gently as it warmed up, then increase
in frequency and amplitude and, in
few seconds, had settled down to a ful
throated scream. It was as good a pos
tive feedback howl as I have ever hear

So much for the rumbling sound fo
a few seconds after switching on.

Subsequently, I disabled each chann
in turn to determine which one wa
faulty, but I needn't have bothered, b
cause both were in the same conditio

It needed only a few moments' wor
with the soldering iron to correct th
feedback circuits, whereupon each cha
nel came good. Using the audio gene
ator I checked each channel on th
CRO and made a rough power outp
test. As far as I could see, each cha
nel was behaving normally, in spite
the rough and ready wiring.

That much established, I plugged i
the control unit. This was complete
dead, on both channels, and I starte

(Continued on Page 91)

EVEREADY

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General features:

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POLARITY REVERSAL: Where discharge is carried below 1.0 volts/cell a very rapid fall to zero volts occurs. Because of slight differences n cell capacity one cell may reach this point before the others and this can result in cells reversing polarity. Whilst polarity reversal causes no damage to 'Eveready' sealed nickel-cadmium cells when discharged at the ten hour rate, it should be avoided for maximum possible life. After normal recharge a reversed cell will regain ts polarity and function normally.

STORAGE: The correct storage temperatures are shown over the page. At storage temperatures of 100°F to 120°F self discharge will increase considerably, as compared to 70°F. Before storage, cells should be given a normal charge and during storage protected from dust and shorting terminals. After storage for prolonged periods, because of self-discharge, the cells will not have their normal capacity. This will be regained after two or three cycles of charge and discharge.

STATE OF CHARGE: There is no simple way to determine the state of charge of nickel-cadmium cells, due to the flat voltage characteristic. Where the state of charge of a cell is unknown, a twelve hour charge at the ten hour rate can be given.

CYCLE LIFE: Cycle life is at an optimum when over-discharge is avoided, re-charging is performed regularly, and depth-of-discharge is kept as shallow as possible. Overcharging at elevated temperatures should especially be avoided. When charge-discharge cycles are nearly full, life is measured in hundreds of such cycles. When partial discharges are used, cycle life may be in the thousands.

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Capacity	mah	225	500	1000		20	50	100	150	225	450	1000	2000	3000
Discharge Current	ma	22.5	50	100		2	5	10	15	22.5	45	100	200	300
Avg. Discharge Voltage	Volts	1.24				1.22						1.24		
Cut-off Voltage	Volts	1.10				1.10								
Charging Rate	ma	22.5	50	100		2	5	10	15	22.5	45	100	200	300
Charging Voltage	Volts	from 1.35 to 1.50							from 1.35 to 1.50					
Cell Weight	ozs.	0.46	1.0	2.0		.04	.12	.32	.4	.44	1.16	2.0	3.4	4.8
Dimensions in inches	Diameter	0.988	1.355	1.984		.449	.610	.988	.988	.988	1.697	1.984	1.984	1.984
	Height	0.347 + tabs.	0.380 + tabs.	0.394 + tabs.		.201	.235	.230 + tabs.	.252 + tabs.	.343 + tabs.	.286 + tabs.	.394 + tabs.	.719 + tabs.	.988 + tabs.

Permissable Temperatures °F		
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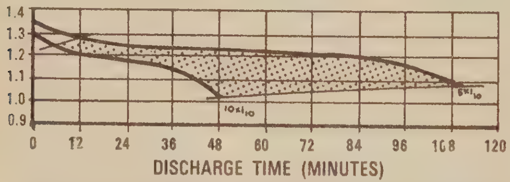
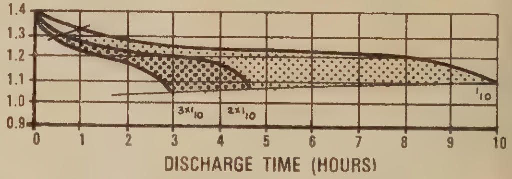
	Discharge	from — 4 to + 113
	Storage	from — 40 to + 140

The maximum continuous discharge current of a high rate cell should not exceed 20 x I_{10}. For momentary periods only cells may be discharged at twice this value.



Voltage during discharge of a fully charged cell at the 2 and 1 hour rate.

The maximum continuous discharge current of a standard rate cell should not exceed 10 x I_{10}. For momentary periods only cells may be discharged at twice this value.



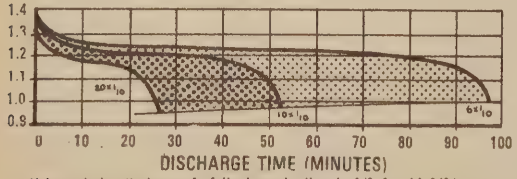
Voltage during discharge of a fully charged cell at the 10, 5 and 3-1/3 hour rate.

EVEREADY CYLINDRICAL CELLS

BATTERY NO.		HIGH RATE					STANDARD RATE				
		CH1	CH1.5	CH4	CH6		C150	C450T	C450	C900	C2
Capacity	Ah	1.0	1.5	4	6		150	450	450	900	2000
Discharge Current	Amps	0.1	0.15	0.4	0.6		15	45	45	90	200
Avg. Discharge Voltage	Volts	1.24					1.22				
Cut-off Voltage	Volts	1.10					1.10				
Charging Rate	Amps	0.1	0.15	0.4	0.6		15	45	45	90	200
Charging Voltage	Volts	from 1.35 to 1.47					from 1.35 to 1.50				
Cell Weight	ozs.	1.4	3.0	5.75	8.5		.42	0.8	0.8	1.4	4.5
Dimensions in inches	Diameter	15/16	1	1-11/32	1-11/32		29/64	17/32	17/32	17/32	1-11/32
	Height	1-27/64	1-15/16	2-13/32	3-39/64		1-9/64	1-31/32	1-31/32	3-35/64	2-13/32

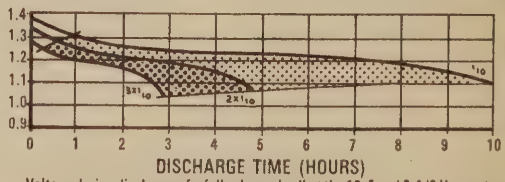
Permissable Temperatures °F		
	Charge	from + 32 to + 113
	Discharge	from — 4 to + 113
	Storage	from — 40 to + 140

The maximum continuous discharge current of a high rate cell should not exceed 20 x I_{10}. For momentary periods only cells may be discharged at twice this value.



Voltage during discharge of a fully charged cell at the 1/2, 1 and 1-2/3 Hour rate

The maximum continuous discharge current of a standard rate cell should not exceed 10 x I_{10}. For momentary periods only cells may be discharged at twice this value.



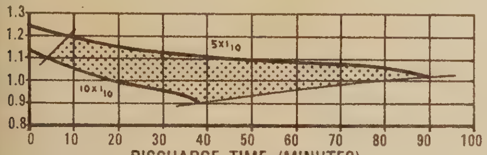
Voltage during discharge of a fully charged cell at the 10, 5 and 3-1/3 Hour rate.

EVEREADY RECTANGULAR CELLS

		HIGH RATE				STANDARD RATE								
BATTERY NO.		**RH1.6**	**RH2.6**	**RH7**	**RH15**	**R2**	**R3.5**	**R4.5**	**R6**	**R7.5**	**R11**	**R15**	**R19**	**R23**
Capacity	Ah	1.6	2.6	7	15	2	315	4.5	6	7.5	11	15	19	23
Discharge Current	Amps	0.16	0.26	0.7	1.5	0.20	0.35	0.45	0.60	0.75	1.10	1.50	1.90	2.30
Avg. Discharge Voltage	Volts	1.24				1.22								
Cut-off Voltage	Volts	1.10				1.10								
Charging Rate	Amps	0.16	0.26	0.7	1.5	0.20	0.35	0.45	0.60	0.75	1.10	1.50	1.90	2.30
Charging Voltage	Volts	from 1.35 to 1.45				from 1.35 to 1.50								
Cell Weight	ozs.	4.1	6.4	12.3	25.3	5.9	9.2	12.3	15.2	17.6	28	34.9	41.6	49.6
Dimensions in inches	Length	1-41/64	1-41/64	2-7/32	3	1-23/64	1-23/64	2	2	2	3-37/64	3-37/64	3-37/64	3-37/64
	Width	23/32	23/32	1	1-3/16	1-23/64	1-23/64	1-23/32	1-23/32	1-23/32	1-1/16	1-25/64	1-45/64	2-1/64
	Height	2-17/32	4-1/32	3-29/32	4-17/32	2-13/32	3-25/64	3-5/32	3-45/64	4-1/4	4-15/16	4-15/16	4-15/16	4-15/16

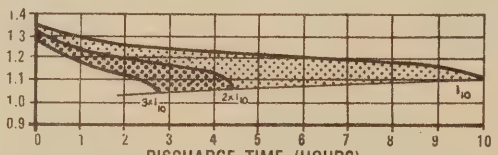
Permissable Temperatures °F		
	Charge	from + 32 to + 113
	Discharge	from — 4 to + 113
	Storage	from — 40 to + 140

The maximum continuous discharge current of a high rate cell should not exceed 20 x I_{10}. For momentary periods only cells may be discharged at twice this value.



Voltage on discharge of a fully charged cell at the 2 and 1 hour rate.

The maximum continuous discharge current of a standard rate cell should not exceed 10 x I_{10}. For momentary periods only cells may be discharged at twice this value.



Voltage on discharge of a fully charged cell at the 10, 5 and 3-1/3 hour rate.

EVEREADY MULTI-CELL BATTERIES

Battery number	Voltage	Nominal Capacity	Type	DIMENSIONS L	W	H	Weight ozs.
3/RH 1.6	3.6	1.6 ah	Rectangular High Rate 3 RH 1.6 cells	2-1/32	1-11/16	2-11/16	12.7
3/RH 2.6	3.6	2.6 ah	Rectangular High Rate 3 RH 2 cells	2-1/32	1-11/16	4-11/32	21
N67	6.0	900 mah	Cylindrical 5 C900 cells	1-15/32	1-15/32	3-25/32	8.3
N70	6.0	1.5 ah	Rectangular 5 R 1.5 cells	3-53/64	1-35/64	3-5/8	28.1

These batteries have the same characteristics as the single cells of which they are comprised.

No. B20 and B50 cells should only be used singularly, such as in Hearing Aid application to replace 675 and 625 type cells respectively. Other button cells may be assembled into a higher voltage series stack of 2 to 10 cells by special factory welding techniques. The assembly is finished with a plastic sleeve and provided with solder tags.

RECHARGING OF NICKEL-CADMIUM BATTERIES

The basic requirement for a battery charger is a source of direct current having a voltage higher than that of the fully charged battery. The positive terminal of the charging source is connected to the positive terminal of the battery so that the charging current flows through the battery in the direction opposite to that of the discharge current.

Constant current charging is not only the cheapest and simplest method but is recommended to prevent the possibility of 'thermal runaway'. It is obtained by making the supply voltage much greater than the battery voltage and limiting the current flow with a large amount of series resistance. Figure 1 shows a typical half-wave constant-current charger. No filtering is required as the cells have a large equivalent capacitance. This circuit should be used for charge currents up to 0.5 amp. For charge currents above 0.5 amp use the full wave bridge circuit of Figure 2. The charging factor is 1.4. For fully or partially discharged cells, 1.4 times the capacity removed must be replaced. The charge current should not exceed the 10 hour rate. Fourteen hours charging at this rate will fully charge a discharged cell. To determine circuit components calculate the battery voltage as 1.5 volts per cell to find Edc. Choose a transformer with a secondary voltage at least twice this voltage and an rms current rating about twice the D.C. charge current value. The diode may be either silicon or selenium with a conservative peak inverse voltage rating and able to handle twice the maximum anticipated current. Subtract Eac from Edc and use this value for E and the 10 hour rate for the value of I and find R using formula R=E/I. The wattage rating of the resistor should be at least twice the product of E and I. The chosen value of R should be adjusted if the D.C. charge current exceeds the 10 hour rate with the actual transformer-rectifier combination at the end of the charging time.

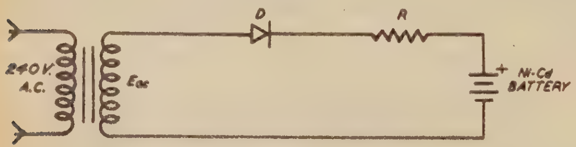


FIGURE 1

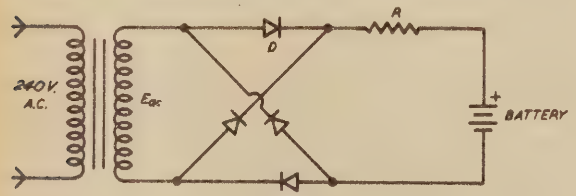


FIGURE 2

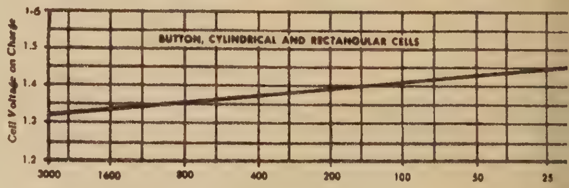


FIGURE 3

TRICKLE & FLOAT CHARGING: 'Eveready sealed nickel-cadmium cells can be trickle charged or floated. The maximum continuous overcharge current should not exceed the 50 hour rate. The trickle charging current required to keep the battery constantly in a fully charged condition should not exceed the 100 hour rate. The cell voltage during further charging of fully charged button, cylindrical and rectangular cells in relation to the charging current in shown in Figure 3.

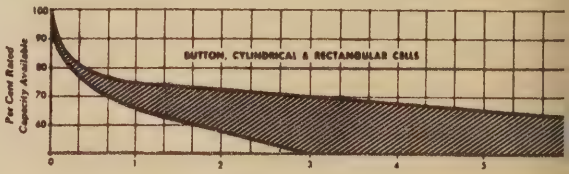


FIGURE 4

SELF DISCHARGE: The characteristics are shown as a decline in percent of rated capacity available. After the first month the capacity decreases only gradually with age. High rate cells lose their charge on shelf at a more rapid rate than standard rate cells. Batteries are not harmed even if not used for long periods of time but may require several cycles to reach full capacity.

EVEREADY TRADE MARK NICKEL CADMIUM BATTERIES — PRODUCTS OF UNION CARBIDE

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SERVICEMAN — Continued

looking for some common factor. I soon established a complete lack of HT, and traced this in turn to a mix-up in plug and socket connections between the two units. The socket on the main amplifier was wired with pin 6 as the control unit HT supply, while the control unit HT line had been wired to pin 7 which, in this case, was a blank pin.

With this mix-up corrected the control unit came good also and, as far as I was able to check it, appeared to have no other faults. Which, considering the obvious inexperience of the constructor, was really rather remarkable.

Nevertheless, I was still puzzled by his original explanation of the rumbling sound which, he had implied, lasted for only a few seconds after switching on. When he came to collect the set, I tackled him about it.

His explanation was disarmingly simple; the sound continued for only a few seconds because, fearing that it might do some damage, he invariably switched it off!

But I was still not satisfied. If he had only switched the set on for a few seconds at a time—presumably to check whether various attempts had cured the "rumbling"—how did he know that the set failed to reproduce signals from the pickup?

Again it was all very simple. He connected the pickup to the control unit, set it on a revolving record, and listened for signals in the few seconds after the valves warmed up but before the feedback became intolerable.

Well, we live and learn!

My next story concerns a TV set with a very erratic tuner. According to the owner the effect was worst when the set was cold and invariably cured itself after about half an hour's running. During that time, however, channel selection would be quite erratic and bear little relation to the numbers on the knob. Nor did there seem to be any regular pattern to the fault. Sometimes channel 7 would appear on position 8, with channel 9 on position 10; at other times 7 would appear on 6, with 9 on 8, and so on. Naturally, neither sound nor picture was at its best in these circumstances.

The first time I called the set was already switched on and running and nothing the housewife or I could do would induce it to misbehave. So I left it, promising to call again in a few days and at a time when the set was not likely to be on.

My second call was more rewarding, and the set behaved exactly as described. It seemed fairly obvious that it was tuner trouble and the most important clue seemed to be that it was an incremental type and, in particular, that it employed an automatic fine-tuning mechanism involving a "memory drum."

This drum was mounted on the channel selector shaft and was fitted with a series of small nylon-tipped screws, one for each channel, on its outer edge on the side facing the tuner. The amount by which each screw protruded from the drum controlled the fine tuning as each channel was selected. It did this by bearing against a short vertical leaf spring, the lower end of which was anchored to the face of the tuner, and the upper end to a plunger type variable capacitor located within the tuner housing.

I slipped the back off the cabinet and took a look at the tuner, which was mounted sideways in this set, i.e., the channel selector and other knobs were mounted on the side of the cabinet. Even so, there was not much room to see what was going on, but with the aid of a torch and a mirror I was able to focus one eye on to the memory drum and capacitor coupling rod.

This much achieved, I tried rotating the channel selector, but there was no movement of the rod. Then I contrived to push a screwdriver blade into the available space and exert gentle pressure on the spring. Neither it nor the rod seemed inclined to move, even with a fair pressure applied.

So that was the answer. The variable capacitor was in the habit of "seizing" during cold spells, and it was easy to appreciate the erratic behaviour this would cause in an incremental tuner. When another channel was selected the one actually received would depend on both the last channel used and the one selected—but was unlikely to be either of them!

From the truck I fetched a small aerosol of moisture inhibitor, which, incidentally, I have found particularly effective in freeing any jammed or seized mechanisms, from rusty bolts upward. It is also invaluable for humidity-affected EHT systems, water-soaked ignition systems and similar situations.

By means of some rather drastic gymnastics I was able to get the aerosol within spraying distance of the capacitor mechanism and gave it a hearty burst. I waited a few seconds, then tried the channel selector knob again. I was rewarded with a sight of the rod moving in and out precisely as each channel was selected.

So that seemed to be that. While I wasn't exactly sure what had caused the trouble it seemed difficult to justify pulling the whole set apart in the face of such an obvious cure. Nevertheless, I took the precaution of advising the housewife to contact me immediately if the trouble showed again.

For a week or so all was quiet, and I rather assumed that that was the end of the story. Then the owner was on the phone and I knew it wasn't. Yes, the trouble had shown up again, and seemed to be worse now than before.

Fortunately I was able to call at the house later that same morning and the set, on switching on, misbehaved again. Anxious to get at it while it was still faulty, I slipped the back off and checked the fine-tune capacitor as before. It had jammed again, and the obvious thing seemed to be to get it out of the cabinet without disturbing it in order that the exact cause could be found.

The tuner was mounted on a small auxiliary bracket, which also carried the other controls, fitted in the front corner of the cabinet. However, to get the tuner out far enough to be examined properly the main chassis also had to be withdrawn. And by the time all that had been done the fault had completely vanished.

I decided the best course was to take it back to the shop and run it on the bench until the trouble showed up. If it was really temperature-conscious, one winter's night in my workshop would bring it on without a doubt.

But it didn't. And nothing else I could do over the next few days did any better. The thing stubbornly refused to misbehave in any circumstances and this was so contrary to its previous behaviour that I began to become suspicious. Could it be that the trouble was somehow tied up with its assembly in the cabinet? While I couldn't see how, there didn't seem to be much future in keeping the set on my bench any longer, while there was just a chance that a more careful examination of the installation might reveal something.

Back at the customer's home I began the job of refitting. All went well until I came to mount the tuner. As I hinted earlier, the tuner and other controls were all part of the same sub-assembly, mounted so as to present the control knobs on the side of the cabinet.

This sub-assembly consisted of an "L"-shaped metal bracket which fitted in the corner of the cabinet. On one leg of the "L"—the one against the cabinet front—was mounted the bottom of the tuner housing—the tuner lying on its side—while on the other leg was mounted the volume control and "on-off" switch, tone, brightness, and contrast controls. The tuner shaft also passed through this leg.

The "L" bracket was held in place by two large countersunk screws, about 3-8in diameter and 1¼in long. These passed through two "push fit" countersunk holes in the side of the cabinet and engaged tapped holes in the bracket.

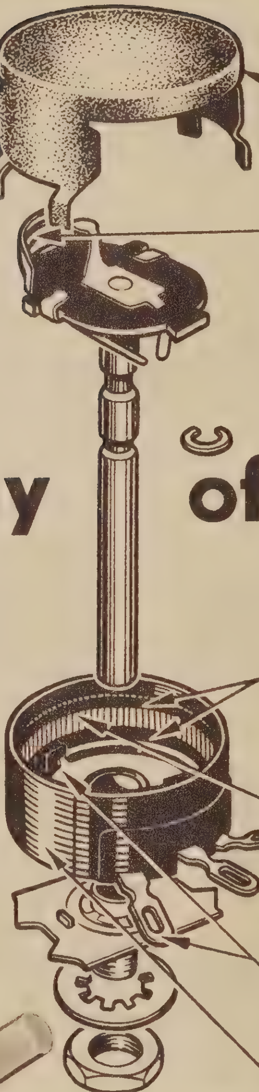
When I came to fit these screws I realised that the cabinet and bracket holes were not correctly aligned, and that it needed a little juggling to get things into place. Even then, one of the screws was under tension and being pulled slightly sideways. Suddenly a thought struck me These screws were a good deal longer than they needed to be. I wonder if—

A quick check inside the cabinet confirmed my suspicions The screw was long enough and so placed that it was sitting hard alongside the leaf spring which actuated the fine tune capacitor. A closer check, using a torch and mirror was even more revealing. These two items were so close together that they appeared to be touching, even though they were not at the moment. Nevertheless, it was easy to imagine that almost any variation of temperature or humidity could effect either the metal or the wood sufficiently to bring the two into contact. And when this happened, the fine tune mechanism was effectively locked.

Also, it now seemed likely that my original "cure" had been nothing of the kind. More likely, the time needed for me to fetch the aerosol was all that was needed for the fault to clear itself in the usual way, i.e., due to the heat from the chassis.

The cure was easy. A little filing in the cabinet hole, plus some juggling of the tuner on its mounting bolts through the "L" bracket provided ample clearance for any likely eventuality.

But what a trap!



Dustproof cover.

Dual finger wiper—makes positive contact over full rotation.

Wire cemented to strip—cannot move or bunch.

Resistance element uniformly wound—for good linearity.

Unique collector ring and terminal design for noise-free operation.

One-piece phenolic moulding—efficient heat sink for better performance.

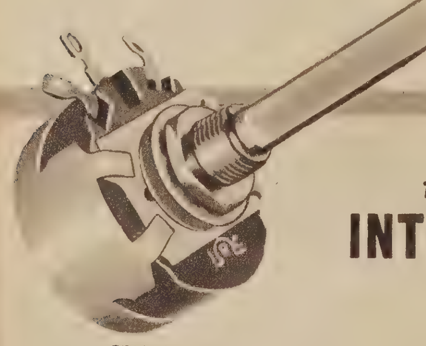
Anatomy of a leader!

ELECTRICAL DETAILS

Power rating: 2.0 watts at 40°C ambient.
Standard resistance values: min 2 ohms, max. 25,000 ohms.
Tolerance: ±10% standard (±5% special).
Effective electrical rotation: 280°.

MECHANICAL DETAILS

Bush mounting: 3/8" x 3/8" (32 N.E.F. —2 thread).
Shaft: standard length 2 1/4" from mounting surface.
Diameter: 1/4".
Overall diam. of potentiometer: 1 1/4".
Overall depth of potentiometer: 21/32".



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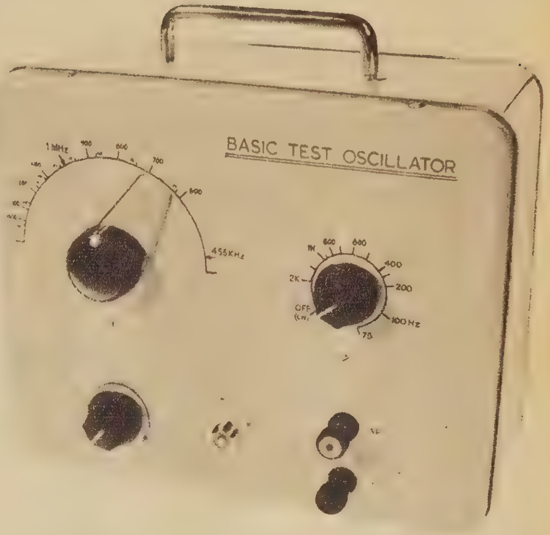
A test instrument for the beginner —

The Basic Test Oscillator

Here's a project designed especially for our younger readers — a simple two-transistor RF-AF test oscillator. Easily built even by those with little or no previous wiring experience, it is both educational and useful as a test instrument. The cost may be quite modest, as many of the parts can be salvaged from old radios; the shielding case may be nothing more than a converted metal cake-tin, as shown.

by Jamieson Rowe



Many of the components used in this simple test instrument may be salvaged from old radio receivers, making it an ideal project for the younger reader.

Although the little two-transistor test oscillator described in this article is about the simplest possible instrument of its type, it is by no means a toy. If properly constructed and intelligently used, it will be found quite a useful instrument for general experimental work and amateur radio servicing. In addition, the educational experience provided both by its construction and from its use should make it an ideal project for youth radio clubs, science classes and the like.

The unit consists of two separate oscillator circuits, each using a single transistor and a handful of minor components. One oscillator is a tunable RF type covering the range 450-1450KHz (KC) on fundamentals, and suitable for performing IF and front-end testing and alignment on broadcast band radio receivers.

The other oscillator is a tunable AF or "audio" type covering the approximate range 75-2000Hz (cps), suitable for signal injection and general testing of audio circuits.

When both oscillators are in operation, the output of the RF oscillator is lightly modulated by the AF oscillator.

As may be seen from the circuit diagram, the RF oscillator is a simple Hartley (tapped coil) circuit using one of the modern low-cost silicon NPN transistors such as the BC108 or 2N3565. Output is taken from a small secondary winding on the oscillator coil, being adjustable via a 2K carbon potentiometer.

Space is not available here to give a detailed description of the transistorised Hartley circuit. However, interested readers will find quite a readable account of the operation of such circuits in chapter 8 of our "Basic Radio Course," published originally in the March, 1964, issue. (Those without this back copy of the magazine may be interested to learn that the complete course will shortly be available in book form.)

Almost any broadcast aerial coil may be pressed into service as the oscillator coil. Particularly suitable are those intended for, or salvaged from, transistor sets — as these will very likely already possess the required secondary winding and a suitable tap at about 15 per cent of the turns of the tuned winding. However, coils from valve sets may be used if they already possess or lend themselves to convenient addition of a secondary winding and the fitting of a tap connection; this will probably be true in a majority of cases.

The case for the prototype unit, in its original form: a metal cake-tin.

For those unable or unwilling to use an existing coil, it is quite in order to "wind your own" on a cardboard, fibre or wooden former. The prototype coil was, in fact, of the hand-wound type, and works quite successfully. Winding details are given later in the article for those who elect to follow this course.

The tuning capacitor is almost as non-critical as the oscillator coil. Almost any gang salvaged from an old receiver may be used, providing that it is in good condition and that it can be fitted within the case comfortably.

Although a two-section gang is shown on the circuit and in the photographs, this is not essential. We used a two-section unit because of the likelihood that this will be the type normally salvaged from old radios. The second section is lightly coupled into circuit simply in order to provide a slightly greater overall capacitance range.

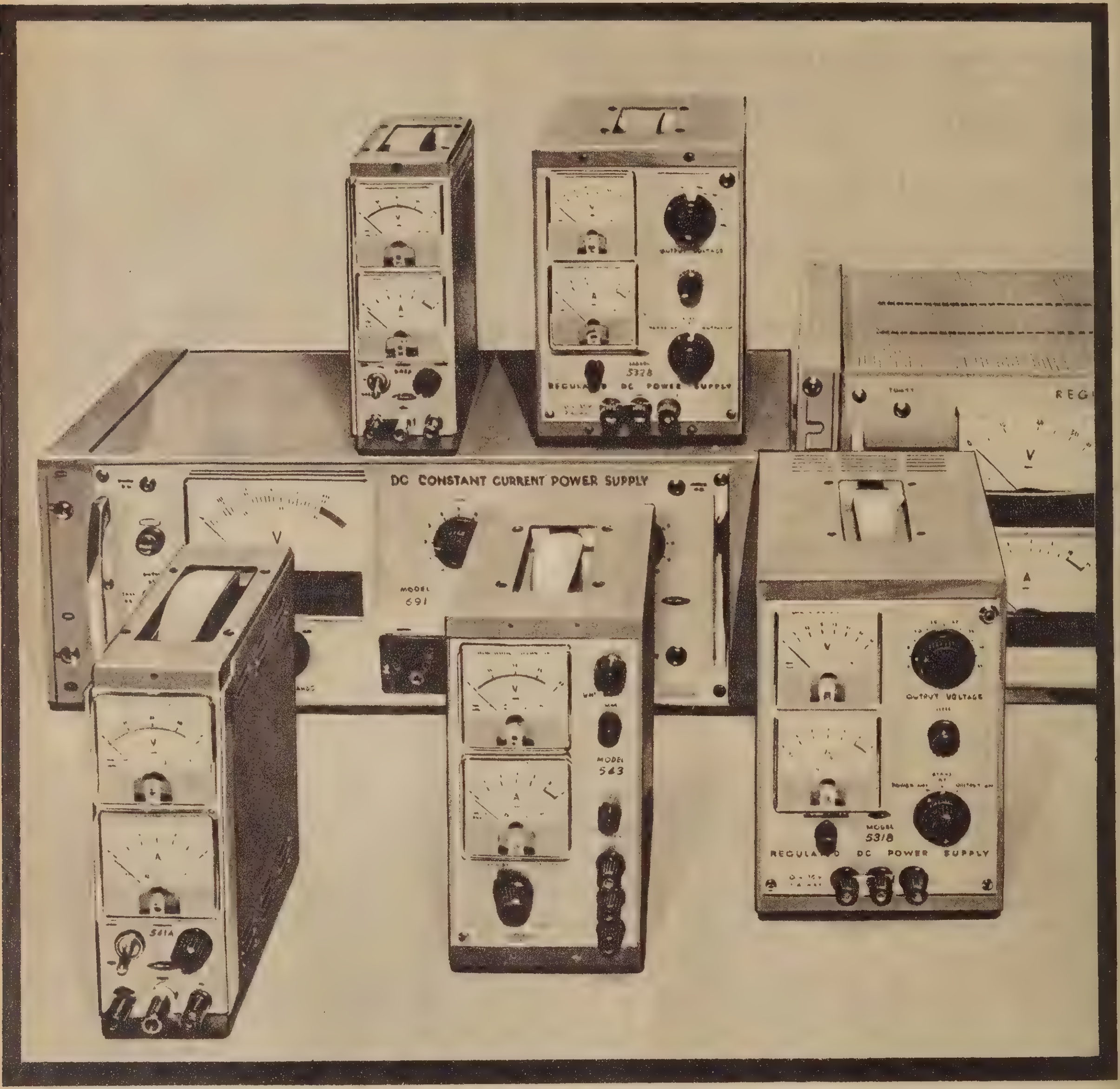
If a three-section gang is used, this can still be done while simply ignoring the third section. But even a single section may be used if one is prepared to tolerate a smaller capacitance range and the resulting smaller frequency range. Such a capacitor would be connected directly between the transistor collector and earth, with a parallel fixed capacitor of 100pF.

As there will normally be quite a useful second harmonic output, the instrument may still be useful over the full broadcast band in the latter case despite the limited fundamental range. The second harmonics give an effective "second band" of frequencies twice those marked on the dial scale. Thus with a two- or three-gang capacitor the second harmonics give a "bonus" range of approximately 900-2900KHz, while with a single gang it should be possible to go to at least 2500KHz.

As with the coil and capacitor many of the smaller components may be salvaged from old radios and amplifiers. Resistor power ratings are virtually unimportant as the power involved is very small; similarly, capacitor voltage ratings are unimportant, as most salvaged units will have ratings far in excess of the levels in this circuit. Providing the components are in good electrical condition and are not

WF | **INSTRUMENTS ELECTRONICS**

Another first from WARBURTON FRANKI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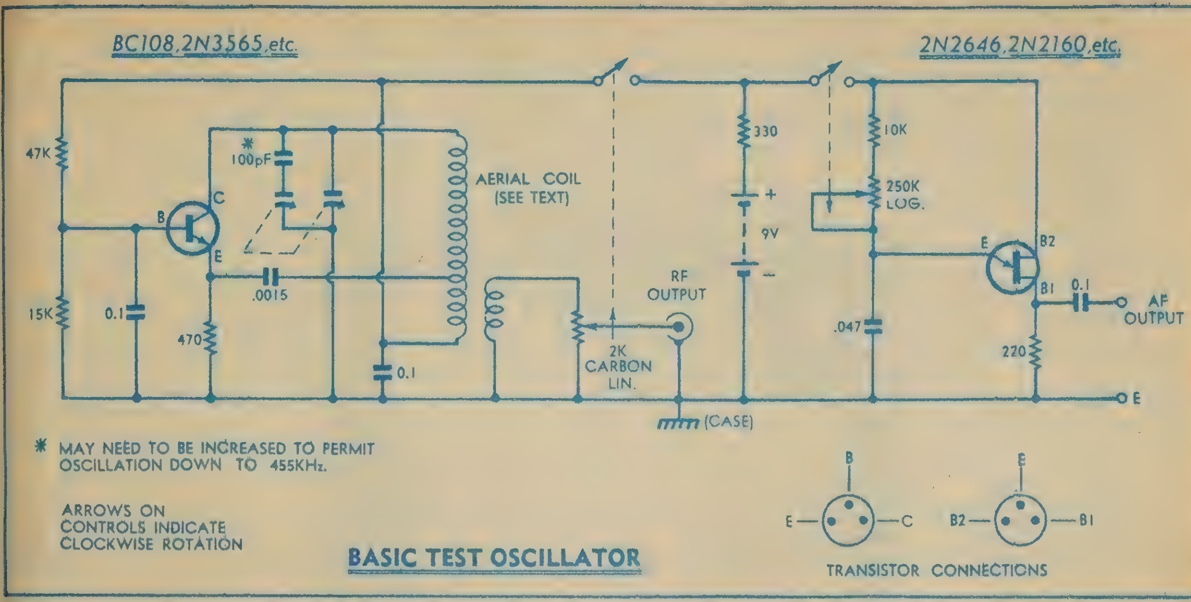
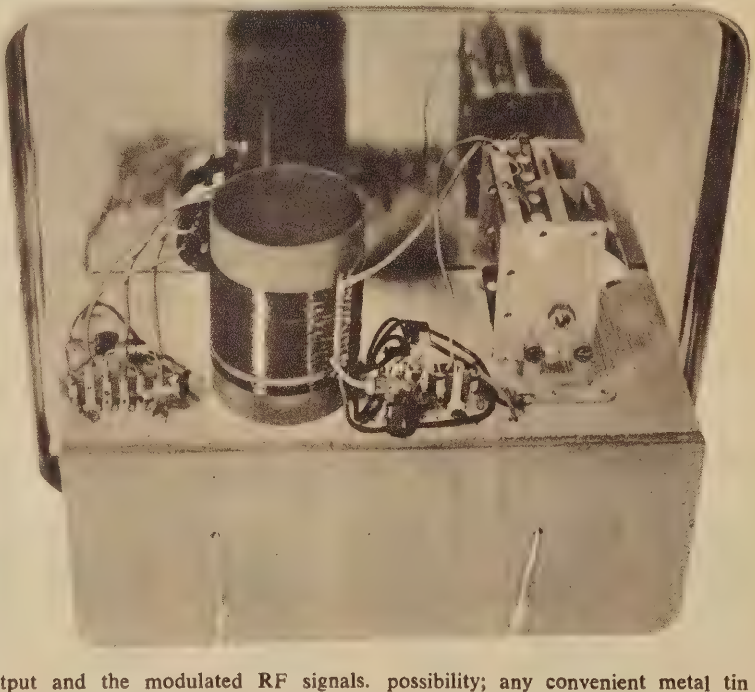


Above is the circuit for the simple test instrument, showing its essential simplicity. Below is a photograph of the interior, showing the wooden "chassis".



unduly large, they should be quite satisfactory.

The AF oscillator is a simple relaxation type featuring a modern, low-cost unijunction transistor such as the 2N2646 or the 2N2160. This circuit has been described and discussed before, for example, in the March, 1966, issue (p. 79), and space does not permit a full description to be given again here.

However, the general idea is that the .05uF capacitor charges up via the adjustable resistance provided by the 10K resistor and 250K pot, to the point where the unijunction conducts and discharges the capacitor through the 220 ohm resistor to generate an output pulse. As soon as this has occurred, the capacitor commences recharging again, and so on; the charging and discharging cycles continue indefinitely as long as power is applied, at a rate depending upon the setting of the 250K pot.

For a more complete description than the foregoing, readers are referred to the March article. Similarly, for a description of the unijunction itself, interested readers could refer to the small article on page 85 of the August issue, the first in the current series entitled "Keeping Up With Semiconductors."

Either of the two oscillators may be used separately, or the two may be used together if desired as they are fitted with separate switches. With the AF oscillator turned off, the RF oscillator delivers continuous-wave or "CW" signals; but if the AF oscillator is turned on at he same time its varying current produces a varying voltage drop across the 330 ohm resistor in series with the battery, varying the supply to the RF oscillator and hence producing a small degree of modulation.

The degree of modulation produced by this simple method is quite adequate o permit use of the modulated signal or alignment of radio receivers. For his application the AF oscillator is imply set to produce a convenient tone — usually at about 400Hz or 1KHz.

The output of the AF oscillator may e used for other purposes at the same me as the oscillator is being used to modulate the RF oscillator. However arying the frequency of oscillation will aturally affect both the "direct" AF output and the modulated RF signals.

Construction of the unit should be a simple matter even for the inexperienced, using the wiring diagram and photographs as a guide. To use this information to best advantage, the reader is urged to compare the wiring diagram with the circuit as he proceeds in order to help himself to become familiar with the symbolic way in which the circuit depicts the **operation** of the components.

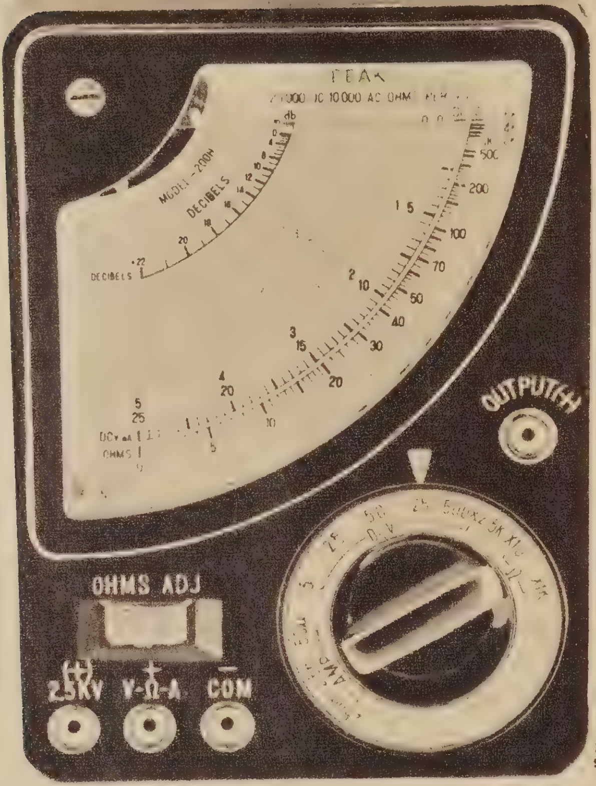
The construction and exact wiring layout which we used for the prototype unit are by no means the only possible ways of doing the job. We simply chose them to serve as a guide for those wishing to use the bulkier components usually obtained from old radios. Similarly the use of a cake-tin as the shield case is simply to illustrate one possibility; any convenient metal tin or case may be used, providing it will house all the components.

Note that a metal case is recommended rather than one fabricated from plastic or wood. A measure of shielding is required in order to reduce radiation — otherwise the RF output potentiometer would be pointless.

To be sure, if the constructor cares to purchase a complete set of modern small-sized components, together with a ready-made small instrument case, the instrument could be made a good deal smaller than is shown. We leave this and other possibilities to the ingenuity of individual constructors.

In general, the circuitry is quite noncritical and there is plenty of scope for experiment. The main thing to remember is that the wiring and construction of the

this is only one from



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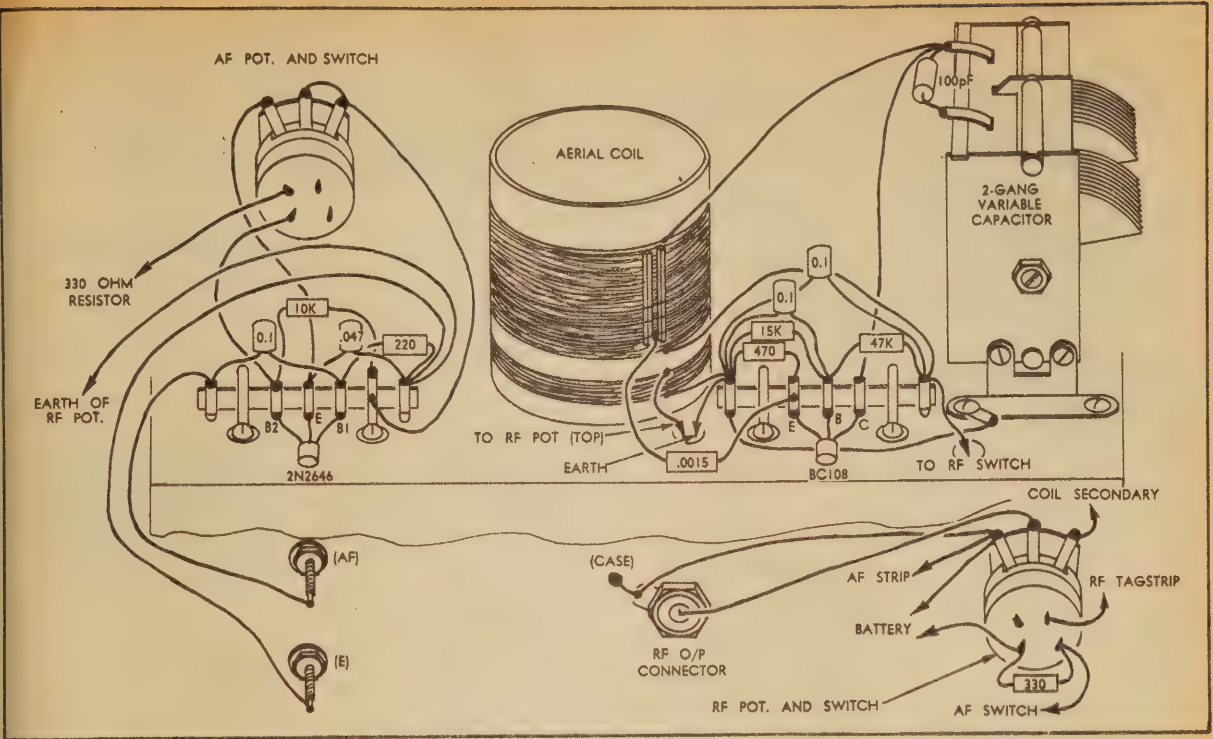

Using this wiring diagram and the photograph and circuit on page 95 it should be easy for the beginner to construct the unit with full confidence.

RF oscillator should be made fairly sturdy and rigid in the interests of frequency stability.

When soldering component leads, particularly those of transistors and the smaller modern resistors and capacitors, take care not to overheat the component itself as this could cause damage. It is best to use a small iron having a fairly hot tip to allow rapid working. To be really safe one should use a pair of long-nose pliers to grip each lead between the component and the solder joint and act as a "heat sink."

The following brief comments may be helpful to those who wish to use a construction similar to our own.

The cake-tin used for the prototype case measured approximately 11½in x 9½in x 4¾in. with a press-on lid. It was provided with the necessary control and terminal holes using a bradawl and a taper reamer, and was then sprayed with two coats of grey automotive lacquer using a small hand sprayer. After the calibrations were added in India ink, as described later, a final coat of clear lacquer was applied to make the markings permanent.

The "chassis" was cut from a scrap of ½in plywood, and measured approximately 9in x 4in. It is screwed to the cake-tin lid "front panel" using three wood screws, while the rear is supported by a scrap of Masonite hardboard. The coil, tuning gang and component tagstrips all screw to the chassis board using woodscrews or "self tapping" metalwork screws. When the instrument s completed four screws of the atter type are used to fasten the lid permanently to the case, while the addition of a chrome handle and rubber feet complete the appearance.

Incidentally, the use of a case as arge as the prototype and the use of a wooden chassis are both recommended where it is intended to use the same sort of home-wound coil, as such coils are not generally suitable for mounting with their ends close to sheet metal. This should be borne in mind when contemplating the use of a smaller case. For such cases it would be best to use one of the smaller can-type coils, or to experiment with a coil wound on a small piece of ferrite material. Note that the battery is fastened beneath the wooden "chassis" using loops of stout string or small metal brackets.

The data table shown should aid those who wish to construct a coil of the type used in the prototype. If the former to hand is of a different diameter to those shown it should not be a difficult matter to scale the number of turns up or down to suit. Note that the smaller the diameter the more turns required, and vice-versa.

At the start and finish of each winding the wire can be anchored by drilling two holes close together and looping the wire through them two or three times; remember to leave 6in or so for connection to the rest of the circuit. If a

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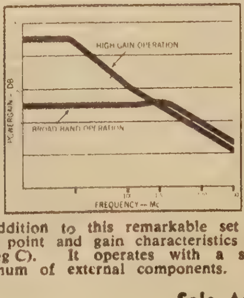

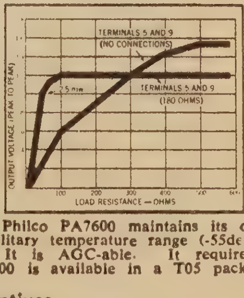

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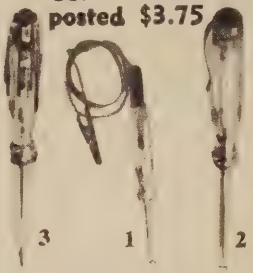

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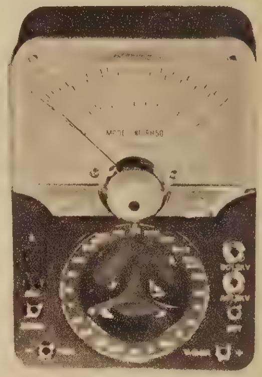

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Capacitance: 250uuF to 1uF, in two ranges.
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DC Current: 0-50 uA, 0-5-50-500mA.
Resistance: 0-6K-600K, 0-6Meg-60Meg. (30) Ohms, 3K, 30K, 440K at centre scale).
Capacitance: 100uuF-0.01uF, 0.002uF-0.3uF.
Inductance: 20 H to 2000 H.
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- ● DC Current: 0-500uA, 25uA, 500mA.
- ● Resistance: 0-20K, 0-2Mg. OHMS.
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wooden former is used small brads may be used in place of the holes.

With the unit constructed the next step is to calibrate the frequency dials. Calibration of the AF dial strictly requires the use of an oscilloscope and either the mains or another AF oscillator; however as these are unlikely to be available the best alternative is to simply copy the marking of the prototype. A close-up photo of the original markings are shown so that this can be done easily.

Calibration of the RF oscillator may be carried out reasonably well using a broadcast receiver and the local broadcast stations. The technique is basically to tune the receiver to each station (whose frequency is known), and zero-beat the oscillator to it.

COIL WINDING DATA BASED ON THE USE OF 24 B&S GAUGE ENAMELLED WIRE				
FORMER	TUNED WINDING			OUTPUT WINDING
	LENGTH	TURNS	TAP	
1½" DIA.	2.75in.	130T	20T	21T
2" DIA.	1.9in.	90T	14T	15T
2½" DIA	1.6in.	75T	12T	12T

For this operation the unit should be provided with a length of wire attached to the RF output, so that it radiates a small amount of signal to be picked up by the receiver close by.

First turn the RF oscillator full on and set its dial to about half-scale. Then turn on the AF oscillator and set it to about 1KHz, to modulate the RF output. It should then be possible to tune the oscillator signal on the receiver near the middle of the band; if there is any doubt that the signal is the right one, try adjusting the AF knob to see whether the tone varies.

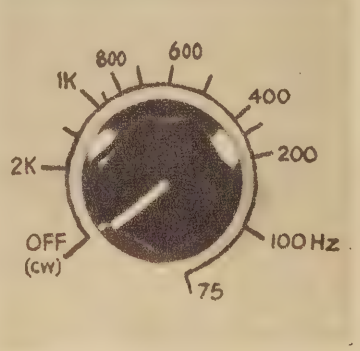
If the signal is rather loud and seems to spread out over the band, this will be because the oscillator is overloading the receiver. In this case try moving the receiver further away. or turning down the RF output of the oscillator. Alternatively or in addition the radiating wire may be shortened or even removed, if sufficient signal is obtained without it (due to leakage from the shield case).

Having determined that the unit is working, the next step is to look up the local station frequencies in a frequency chart (such a chart was published in our January 1964 and January 1965 issues, and is available from our Information Service).

Using these frequencies as a guide it should be fairly easy to set the receiver dial to 910KHz. The reason for doing this is that 910KHz is twice the standard receiver intermediate frequency (IF) of 455KHz, so that with the receiver set to this figure it may be used to detect the **second harmonic** of the RF oscillator, when the latter is operating on 455KHz. This permits the receiver to be used for calibration even though 455KHz is below the usual band covered.

Accordingly, with the receiver set to the best estimate of 910KHz, tune the RF oscillator down near its lowest frequency—still modulated—and see if a faint second-harmonic signal can be heard. If so, the dial can be marked with a short line and the appropriate marking "455KHz;" if not, either the oscillator may need to be moved closer to the receiver to produce a higher signal at the second harmonic, or the capacitor marked with an asterisk may need to be increased to bring the lower frequency limit down past 455KHz.

Once it has been found that the range includes 455KHz, and the latter point is marked, the rest of the calibration is fairly straight-forward. Turn off the AF oscillator to remove the modulation; then tune in the receiver to each station in turn and adjust the oscillator to the same frequency by tuning until a whistle is heard, and then adjusting for the "dip" or **zero beat** in the centre of the heterodyne.



A close-up of the AF scale markings, to guide readers in marking their own scales.

Once the positions on the dial corresponding to the local stations have been plotted, the final step is to work out the calibrations corresponding to the hundreds of KHz—600KHz, 700KHz, and so on. These are found by **interpolation:** work out from the chart the frequency difference between the stations, divide up the dial distances into the appropriate divisions, and this will show fairly closely where the main divisions occur.

For example in Sydney, stations 2FC and 2BL are on 610 and 740KHz respectively—the difference between the two is thus 130KHz. Once the two have been plotted on the dial, divide the distance between the two in the ratio 9:4, with the larger segment nearer 2FC. Then the division line corresponds fairly closely to 700KHz.

In the same fashion, 600KHz will be placed by marking a point below 2FC by a distance equal to one-ninth of that between the latter and the new 700KHz mark. And so on, for each of the other sections of the dial.

When calibrating the dial take care

(Continued on Page 149)

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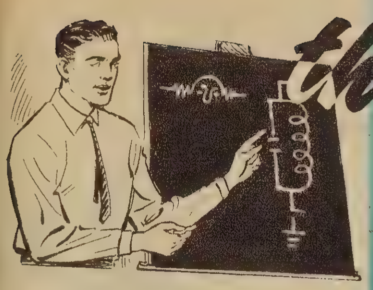


the "Answer Man" Explains

ANTI-MATTER — Is it or isn't it?

The first question, this month, is one which it seems almost impossible to answer without becoming involved in an argument. But we've been asked, so we'll have to take the risk.

What is anti-matter? Is it something real or a figurement of science writers' imagination?

It probably wouldn't be far from the truth to answer the latter question with one word: "Both."

The basic notion of anti-matter has been tossed around for a long time. We haven't done any research to see for how long but one reference we noticed recently put the first "hint" of it in the mid-1850's, as the outcome of some then current scientific research and speculation.

It remained in the area of speculation for many long years, while scientists were busily filling in their knowledge of matter, molecules, atoms and sub-atomic particles.

We now accept that all matter — at least as we know it—is made up of atoms. Atoms, in turn, are composed of a central nucleus around which whirl a number of electrons, rather like a microscopic solar system.

As a purely arbitrary measure, we have defined electrons as being "particles" with a negative electric charge and the nucleus as having a net positive charge. In a normal atom, the number of electron (negative) charges exactly balance the positive charge in the particular nucleus.

In recent years, scientists have learned to "manipulate" the atomic structure. This is the basis of solid-state physics — transistors and so on — and, more spectacularly, the basis of atom bombs. In the latter case, there is an actual translation of mass into energy, in line with the now classic Einstein formula:

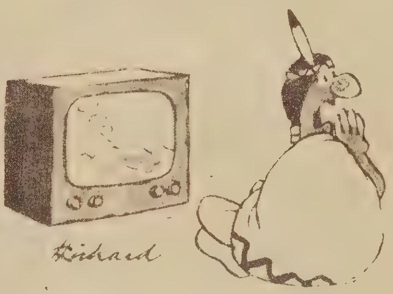
$$E = mc^2$$

where E stands for energy, m for mass and c the speed of light.

The anti-matter proposition is that matter could conceivably exist, structurally similar to matter as we know it, but made up of positively charged particles orbiting around a negatively charged nucleus.

It is further postulated that if matter and anti-matter were brought together physically, each would cancel an equivalent amount of the other, so that the physical mass would disappear, being transformed into equivalent energy.

Besides such a mass-energy transformation, atomic explosions as we know them would pale into insignificance.



"Hey, the news is on!"
— *TV Times*

This basic concept has proved more than adequate for massive development by science fiction writers and there has been a tendency for the fiction aspect to overwhelm the germ of scientific possibility.

Fortunately, in one way, the anti-matter theory is very difficult to prove. If a particle of anti-matter were to reach our earth in some devious manner, or if such a particle were created, it would immediately be annihilated by the first conventional particle which it encountered and we would probably be none the wiser.

However, bombardment of the atomic nucleus in science laboratories has brought to light many "particles" other than the protons and neutrons which were originally expected. So also has cosmic ray research.

Some of these particles are complementary (positive and negative) pairs which could include the building blocks for anti-matter. Among them is the so-called positron, which would appear to be the electrical converse of the electron. As one might imagine positrons don't last long in an environment of electrons!

Nevertheless, such observations lend credence to the anti-matter concept.

The vital question is: Does anti-matter exist in large quantities and, if so, where?

We can take comfort from the fact that the moon is certainly not made of it. If it were, earth-derived objects landing on its surface would have raised more than a small cloud of dust!

In fact, it is reasonable to assume that not only the solar system but the galaxy of which we are a part is composed of conventional matter.

But what of other galaxies?

Is it possible that some of the fantastic energy levels detectable from spots in outer space are from matter-galaxies and anti-matter-galaxies engaged in mutual collision and annihilation?

The first man to come up with an answer to that one gets a medal — a real big one!

★ ★ ★

I was interested in the article in the July "Answer Man" about zener diodes but what about their practical use?

A good question!

In actual fact, the article in the July issue was the first half of a complete paper on zener diodes, by J. M. Waddell and D. R. Coleman, published in two issues of the STC Components Review. The second part of the article was devoted, in large degree, to a closer study of zener diode characteristics and directed more to design engineers.

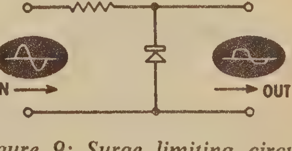


Figure 8: Application as a voltage regulator or reference source.

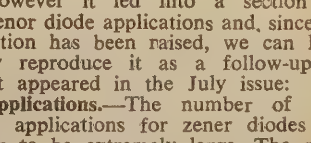


Figure 9: Surge limiting circuit using a zener diode.

However it led into a section on Zenor diode applications and, since the question has been raised, we can logically reproduce it as a follow-up of what appeared in the July issue:

Applications.—The number of possible applications for zener diodes appears to be extremely large. The most obvious applications are as voltage regulators and voltage reference sources (figure 8).

For regulator application a low slope resistance and high power handling capacity are desirable features, while

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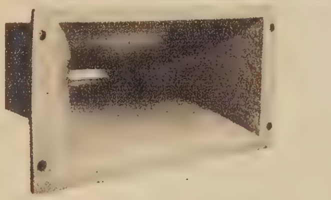

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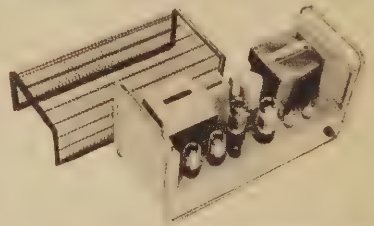

The LUX CORPORATION is regarded as one of Japan's leading manufacturers . . . LUX amplifiers were used at the Olympic Stadium in Tokyo — the NHK broadcasting network uses LUX equipment. From LUX Encel Electronics now offers high quality mono and stereo power amplifiers . . . here illustrated is the LUX MB 8A mono power amplifier. With an output of 70 watts RMS (200 watts IHMF), power/frequency response from 20-20,000 plus c/s, the MB 8A may be regarded as the ultimate type mono power amplifier. Write for full details and prices. (P.S. Two MB 8A's can be used for stereophonic use.)

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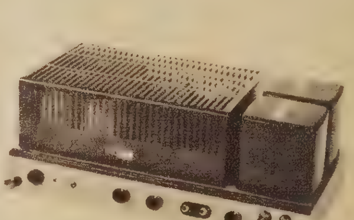

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for reference purposes, stability of reference voltage with time and a low temperature coefficient are the most important factors.

Suitably chosen voltage reference zener diodes appear at this moment to be comparable with industrial standard cells in their voltage stability.

Another large field of application lies in the use of zener diodes for surge limiting and waveform clipping, etc. Figure 9 shows a circuit which gives both top and bottom clipping using only one diode. This circuit makes use of the fact that zener diodes, being in other respects normal silicon rectifiers, have a forward characteristic which may be used on many occasions. The same circuit may also be used for protecting transistor circuits from line surges.

If a balanced clipping action is required, two zener diodes should be used connected back to back (figure 10). Some manufacturers now make special clipper diodes for this purpose.

Zener diodes have a much lower AC resistance than DC resistance (dE/dI is much lower than E/I) which means that they behave like a capacitor or battery. They are particularly useful for coupling and decoupling elements in DC amplifiers, where capacitors cannot be used because of the rise in impedance at low frequencies. Even in AC circuits at low frequencies the zener diode may be more economical than a large capacitor, especially in space.

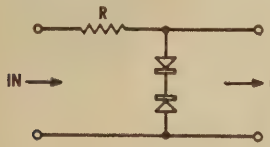

Figure 10: Balanced clipping circuit using back-to-back diodes.

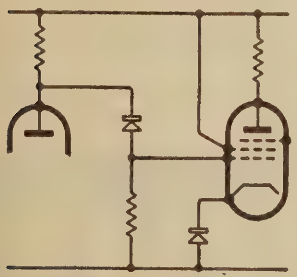

Figure 11: Zener diodes used for coupling elements and cathode bias in a DC amplifier.

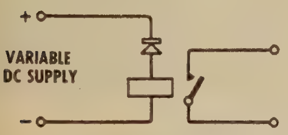

Figure 12: Application as a voltage-sensitive relay.

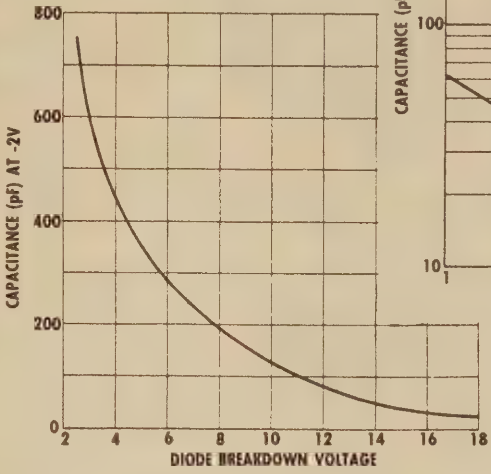

Figure 14: Capacitance effect over a range of zener diodes.

Figure 11 shows the use of a zener diode as a coupling element and for fixed cathode bias in a DC amplifier.

Figure 12 shows a method of obtaining a robust and inexpensive voltage sensitive relay; the relay should operate with a low voltage across it and thus the zener diode used must be capable of passing a reasonably large current. Zener diodes can be made capable of handling quite large powers. Figure 13 shows the characteristic of an experimental 150-watt unit intended for shunt regulation of power supplies, to operate between 2 and 20 amps.

A further useful property of silicon junction diodes (such as zener diodes) is their "self capacitance."

In addition to the electrostatic capacitance between the diode leads or between the leads and metal case, there is a "self capacitance" associated with the junction itself; because the depletion layer is extremely narrow in a zener diode, the junction capacitance is usually much greater than the case capacitance.

This "self capacitance" is seen when the diode is biased in the reverse direction below the breakdown voltage. Figure 14 shows the variation over a range of zener diodes, the capacitances being measured at the same low voltage for all diodes in the range.

In addition, for any one diode the capacitance depends upon the bias voltage applied. Increase of bias voltage up to the breakdown value causes a reduction of capacitance, as illustrated in figure 15. The voltage-dependent capacitance has applications in automatic frequency control. With an FM tuner, for example, the diode may be used as part of the tuning capacitance, whose value is controlled by the output from the discriminator.

It is hoped that sufficient has been said about these new components to stimulate interest in their application and to give some guidance in their use. Much remains to be learnt of their characteristics and possible applications. Perhaps this article will help to speed the process.

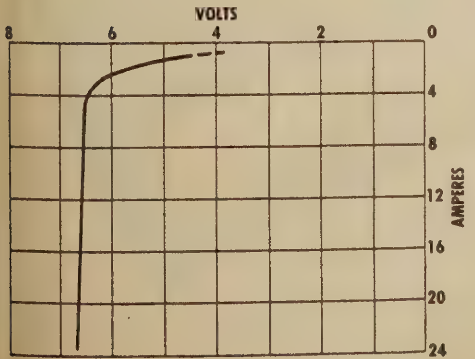

Figure 13: Characteristic of an experimental high-power shunt regulator zener diode for the region 2-20 amperes.

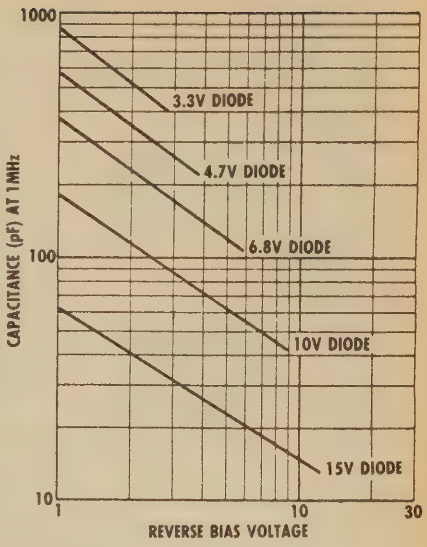

Figure 15: Typical values of capacitance for reverse bias voltages before the breakdown region (at 25°C).

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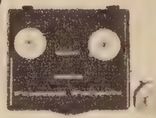

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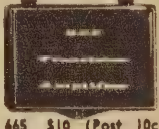

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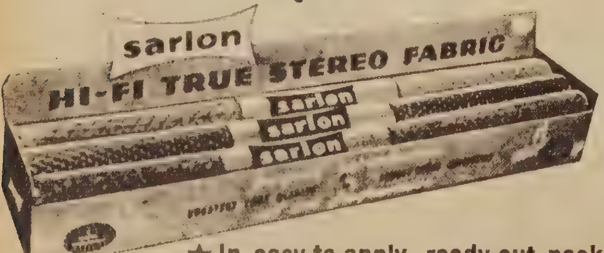

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. . . the PNPN or "Shockley" diode

Two-terminal or "diode" devices having four silicon layers arranged to form three junctions in a PNPN configuration are known variously as "four layer" diodes, "breakover" diodes or "Shockley" diodes. The latter name honours the physicist W. Shockley, who described such a device in 1957.

As shown in figure 1(a) the PNPN diode is usually connected so that the connection to the P-end or "anode" is taken to the positive supply polarity and the N-end or "cathode" taken to the negative polarity. The load is placed in series with the diode and supply.

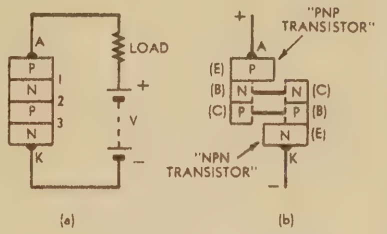

Fig. 1

The basic operation of the PNPN diode may be understood if the structure is conceived as a complementary transistor pair.

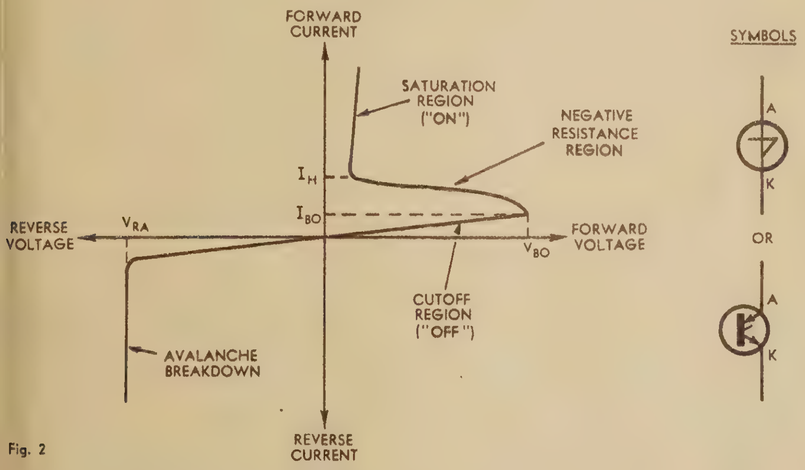

Fig. 2

The characteristic of a typical PNPN diode, showing the important voltage and current values. Of the two symbols, the lower is preferred.

It may be seen that this connection has the result that the P-N junctions 1 and 3 of the device are potentially forward biased, but the N-P junction labelled 2 is reverse biased. Because this centre junction is reverse biased, the device as a whole tends to exhibit the characteristic of a reverse biased junction — i.e., it tends to act as a very high resistance. Only leakage current flows; and as the semiconductor material concerned is silicon this leakage is very small.

This non-conducting or "off" state of the device is not the only state possible, however, for the PNPN structure can alternatively assume a heavily conducting or "on" state. Two basic principles determine the ways in which it may be "switched" to this second state.

The first of these is that by virtue of its PNPN structure the device **tends to amplify its own leakage current.** As suggested by figure 1(b), it acts like a combination of two transistors — a PNP (the three upper layers) and an NPN (the three lower layers) — which share the one collector-base junction; the base of each "transistor" is the collector of the other.

Because of this interdependence and the fact that the collector "output" current of one flows across the "input" or base-emitter junction of the other, the two "transistors" virtually amplify each other's leakage current.

The second basic principle of operation is that **with all silicon devices there is a characteristic dependence of current gain upon the actual current level.**

At low current levels the gain is very low; only as the current is raised does the gain become significant. Thus in the PNPN structure the two inbuilt "transistors" are virtually only present above a certain current level. Below this current level their current gains are insignificant and the structure passes only leakage current in its "off" state.

However if the current **in even one** of the three junctions of the device is increased in some way, the gain will rise. And if the current is raised to a point where the total gain $(\alpha_1+\alpha_2)$ approaches unity, regeneration occurs. The current increases the gain, the gain the current, the current the gain, and so on.

The current rises rapidly, while the voltage drop of the device falls rapidly to the point where the two inbuilt "transistors" saturate: about 0.7V. Since the current gain falls sharply again at saturation, the device remains stably in this "on" state as long as the external circuit permits the flow of a minimum "holding" current **Ih.** In the "on" state the upper current limit is determined solely by the external circuit resistance and voltage.

There are a number of ways in which this "turn-on" mechanism may be initiated, each way employing a different means of producing the initial increase in current; for example in the case of the thyristor or SCR, carriers are injected from an external circuit via a "gate" electrode connected to one of the two centre layers.

In the case of the PNPN diode, use is made of the fact that leakage current is proportional to applied voltage. Thus, simply by increasing the voltage V across the device, the leakage current itself may be increased to the point where regeneration occurs. This is illustrated by the curve in figure 2, where **Ibo** is the critical current value and **Vbo** the corresponding "breakover" voltage. With suitable design, Vbo may be arranged to lie anywhere from a few volts to many hundreds of volts.

PNPN diodes are finding increasing use in switching and digital circuitry as bistable elements, oscillators, pulse shapers and generators. (J.R.)

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Some plain talk from Kodak about tape:

SENSITIVITY, FREQUENCY RESPONSE and Kodak Sound Recording Tape

Controlling every electrical factor involved in the making and using of sound tape is a bit like trying to watch a three-ring circus . . . it can be done, but you need fast eyeballs. To give you a picture of a few things that need looking after, it might be a good idea to list the factors as a group and then go over them one at a time. They are:

High-Frequency Sensitivity
Low-Frequency Sensitivity
Frequency Response
Print-Through
Undistorted Output
Modulation Noise—Low Frequency
Signal-to-Noise Ratio — H.F.
Signal-to-Noise Ratio — L.F.
Saturated Output

Sensitivity means the same in tape technology that it does under any electronic condition: the degree of output for a given input. We put in a 400-cycle signal and measure the output. The result is low-frequency sensitivity.

We choose 400 cycles for a number of good reasons. Let's do a little arithmetic. A 400-cycle note recorded at 15-inches-per-second gives us a wave length that the tape "sees" of roughly .0375 inches, and by a happy coincidence this wave length penetrates the entire depth of the oxide coating, but not the support material. Why must the wave penetrate the entire coating for a low-frequency test? Simple, everything else being equal, low-frequency response is a function of the thickness of the coating. The thicker the coating, the better the bass response. If you want a tape that is flat way down low, then we have to test at a frequency that penetrates the entire coating. We choose 400 cycles instead of, let's say, 20 cycles because the 400-cycle note tells us just as much — and has an added advantage. An engineer can hear 400 cycles. So we have audio monitoring, as well as instrumented observation on the face of a scope.

Just as the low-frequency sensitivity test gives us an idea about oxide thickness, the high-frequency test gives us a fairly accurate picture as to just how smooth the surface of the tape is. Good high-frequency response is impossible on a tape having a rough surface. For one thing, high frequencies affect fewer oxide particles. If the tape surface is rough, the low points will represent gaps in the oxide and cause a loss of H.F. response. We test our high-frequency sensitivity at 15,000 cycles. At 15 ips this gives us a recorded wave length of 1 mil (.001 inches).

Now at this high frequency (short wave length) we are getting a skin effect. We are recording only on the surface of the tape. If any roughness is present, big troubles result. For example: If you have a surface condition where the amplitude of the roughness is just .0001 inches, you will lose 5.5 db in high-frequency response! While you are recovering from that startling bit of news, let's re-phrase the catastrophe. It takes a surface variation of just one ten-thousandth of an inch to knock down high-frequency response by a factor of almost four!

If you haven't suspected it up to now, we are working toward making a vital point about tape technology. And here it is: Kodak Sound Recording Tape has a surface that is unsurpassed in smoothness. Surface smoothness for Kodak tape varies no more than 25 to 50 millionths of an inch from a theoretically perfect plane. That's smooth!

A frequency response calculation is merely the arithmetic subtraction of high-frequency sensitivity from low-frequency sensitivity. Ideally the response is zero because we want to hear all the vigor and nuances of the original. Of course, frequency response is the product of the responses of the microphone, the recording and reproduce circuits and the tape. Our objective as a tape manufacturer is to give you enough output at all frequencies so that you can achieve flatness without straining the noise and distortion levels of your components.

It's quite an easy matter to juggle the characteristics of the oxide around so that frequency response is nice and flat. For instance, if your oxide has poor high-frequency sensitivity, you can reduce the thickness of the oxide layer. This will degrade L.F. sensitivity, and thus effect a flat response. But is the resulting L.F. loss worth it? We don't think so. That's why we designed our coating to give us superior low and high-frequency sensitivities, as well as a nice flat response.

KODAK
SOUND RECORDING TAPE
Extra Play
TYPE 21P

Kodak Sound Recording Tape in a complete range of types and lengths is available at your nearest Kodak Branch.

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AUDIO TOPICS

PWM amplifiers — The case for the X-20

As we noted last month, there was a considerable amount of interest in the Technical Editor's June article on PWM amplifiers. For the most part, the readers' letters published sought to defend PWM as a general principle rather than the Sinclair X-20 amplifier to which Mr Rowe made rather critical reference. In view of this, we think it only fair to risk the charge of prolonging the controversy by affording space to the most recent letter received.

The letter deserves undeniable consideration, for it comes directly from the designer of the X-20 and the managing director of Sinclair Radionics Ltd., Mr C. M. Sinclair. Mr Sinclair's letter is a long one but we publish a considerable proportion of its contents in the belief that, as designer of the X-20 and a recognised authority on PWM, he can rightfully expect "a fair go."

Purely to conserve space, we have condensed some of the phraseology and omitted Mr Sinclair's first, second and sixth points, because these have to do with an error made in the original article regarding the desirability of "clipper-type" scanning. This error and its implications were discussed last month and the points are conceded to Mr Sinclair **post hoc.**

Here, then, is the major part of Mr Sinclair's letter, together with brief interspersed comments from Mr Rowe:

"Dear Sir,

"One of your readers, Mr ——, of Victoria, has sent us the June issue of your magazine, which contains an article describing PWM amplifiers and, in particular, our X-20 amplifier.

"I am pleased to see so much attention given to this subject, but I regret to say that your author has made several technical errors. He has also made some mistake in setting up the X-20 he tested as the wave-forms he reproduces bear little relation to those obtained from a correctly connected X-20. As far as I know, we are the only company in the world to have produced a PWM amplifier and it would be a great pity if this technique died an unnatural death through misunderstanding.

"I would like to deal with the points I disagree with in Mr Rowe's article in the order in which they occur and I have numbered these for convenience.

"1. The article states that it is preferable to use a Schmitt trigger rather than a transistor clipper to 'scan' the triangular waveform. This is not so.

(Mr Sinclair's discussion of this point is omitted as it hinges directly upon the admitted error regarding clipper scanning.)

"2. With respect to figure 3, Mr Rowe states that, unless the 'scanning slit' is infinitely thin, second harmonic distortion will occur because positive and negative half-cycles of audio will be treated differently.

(Again, the discussion of this point is omitted, as it also follows from the admitted error.)

"3. Mr Rowe says that practical filters are inefficient and that they tend to influence the switching speed of the output transistors. The simplest and most practical type of filter is a high Q inductor as used in the X-20, which most certainly does not dissipate a significant amount of power; the only effect it has on switching time is beneficial, as it helps the transistors to turn off rapidly.

Mr Rowe: I agree that a simple series inductor would dissipate little power and that it will tend to assist the switching of the transistors. But granting this, is a simple series inductor really good enough?

Most references I have seen claim that it is definitely not so, particularly if it is desired to apply audio feedback; and there is similarly a good deal of agreement that such feedback is desirable, in the interests of quality.

Even in the case of a non-feedback amplifier like the X-20, it would appear that the inductor is scarcely adequate from the point of view of radiation reduction with the further possibility that the inductor itself may radiate. Our own finding and those of Mr Sinclair's correspondent, mentioned later in his letter, suggest that shielding of the speaker leads is virtually imperative.

"4. With regard to efficiency, I agree with Mr Rowe that the overall consumption of a practical PWM amplifier may not be greatly less than that of a class-B amplifier, but it would be more realistic to compare the amplifier with a conventional class-A unit, since the advantages of this type are retained at enormously less consumption. The most important point, however, is that the output transistors have to dissipate far less heat than in any other type of amplifier.

Mr Rowe: The degree to which PWM retains the advantages of class-A is a moot point and is discussed further, later on. As I have pointed out a couple of times already, the dissipation of the output transistors is a complex function of such practicalities as driving waveform, switching capabilities, circuit design and the load impedance. I grant that, with all these defined as "ideal," the output transistors in a PWM amplifier have the lowest dissipation. The core of the matter is how closely the practical conditions approach the ideal.

"5. Mr Rowe states that PWM simply exchanges one linearity problem for another, since it is as hard to generate a linear sawtooth waveform as it is to amplify linearly. Again this is not so, if we remember that we normally need to amplify linearly with an output of 10 watts or more. It is no problem at all to make a linear amplifier with an output power of only a few milliwatts and it is similarly no problem to produce a linear sawtooth waveform of only a few milliwatts.

"The sawtooth waveform in the X-20 is produced by a capacitor feedback type of integrator. This type of circuit is simple and very effective. The linearity is directly proportional to the voltage gain of the amplifier between whose input and output the feedback is applied. In the case of the X-20, the integrator amplifier has a gain of about 500!

Mr Rowe: Admittedly a linear amplifier must remain so right up to the output stage, and that the latter may be called upon to deliver power of the order of 10 watts. But surely the enormous number of both valve and transistor designs in existence testifies that this is not a particularly hard criterion to meet. With standard components, good design and moderate negative feedback it is not particularly hard at all to reduce THD to 0.2 per cent or less at 10 watts, using normal linear circuitry.

I think there is genuine doubt that this sort of performance is obtainable from transistorised PWM amplifiers, unless one is prepared to go to quite inordinate lengths. I note that in all the discussion to date no one has succeeded in demonstrating otherwise.

With regard to the simple one-transistor Miller integrator used in the X-20, I must first express incredulity regarding the claimed voltage gain of the stage, without feedback. The transistor concerned has an effective load of about 1.5K, so that to produce the gain of 500 the transistor must have an hfe/hie quotient of about .333 milli-Mhos — a most impressive figure indeed. I have no means of identifying the transistor which gives this performance, unfortunately, as the transistors on the sample X-20s sent for review are lacking the usual type numbers . . .

Nevertheless if we grant the gain figure of 500 and take into account the effect of transistor input resistance in the Miller circuit, a rapid calculation suggests that this would still only give a minimum triangular wave linearity

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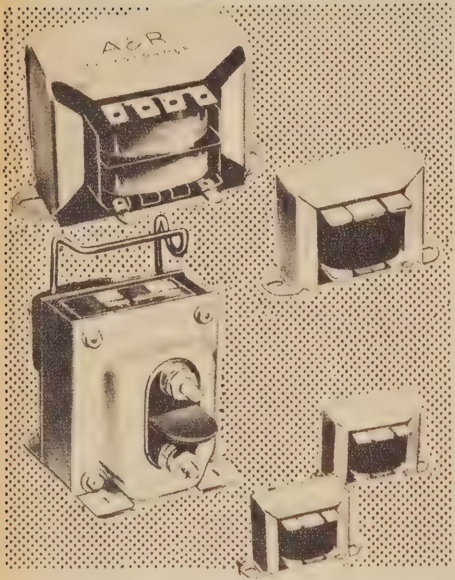

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rror of about 1.5 per cent. Although his order of linearity error could hardly e seen on an oscilloscope, it would urely give the resulting amplifier a THD of considerably more than the 0.1 er cent claimed in the X-20 literature. ncidentally I note that Mr Sinclair nakes no mention of the measurement nethod used to obtain the latter figure.

"6. The article claims that single-edge nodulation is preferable to double-edged nodulation from the point of view of listortion and then goes on to say that PWM produces spurious and unwanted nodulation products.

(Again a segment of the discussion is mitted because Mr Rowe has already onceded his error regarding clipper-ype scanning. However Mr Sinclair oncludes his discussion of this point vith the following reference to a paper y Dr C. H. Miller, which we include ecause of its likely interest to readers.)

"This subject is covered very thoroughy in an excellent paper by C. H. Miller entitled 'High Efficiency Amplifiation Using Width Modulated Pulses' in 'Proceedings I.R.E.E. Ausralia' (May, 1964). Mr Miller gives a omplete analysis of the types of amlifier we are discussing and shows a lock diagram of the type of amplifier e recommends which is identical to hat of the X-20, although we designed ur amplifier before the paper appeared. Furthermore, he writes as follows:

"'As a very linear triangular wave an be generated, the distortion of the ignal frequency component of the nodulated pulse waveform can be made quite small. Using simple circuitry, the nethod shown has given a harmonic disortion of 0.03 per cent for 100 per ent modulation of the pulse width.'

Mr Rowe: Just to set the record traight, Dr Miller's paper gives no clue is to the actual circuitry used to achieve hese particular results. He certainly does ot suggest that transistor circuitry was nvolved, nor does he qualify the description "simple" as applied to the setup vhich gave these figures.

"7. Mr Rowe is again in error when e says, 'In principle, the filter isolates he speaker from the transistors, transorming the latter into an effective audio enerator of somewhat indeterminate ource impedance.' From this he claims hat the damping factor will not be igh, as we claim for the X-20, and that he transient response will not be good. But the choke is simply a low pass filter nd so it does not materially affect the utput resistance of the amplifier at audio requencies. The equivalent circuit of a ormal magnetic speaker includes a eries inductance at least as large as he choke on the X-20, so if Mr Rowe vas correct there would be no point in lesigning amplifiers with high damping actors!

"It is true that some shielding is often ecessary to prevent interference from PWM amplifiers, but this is not difficult o provide and is surely a small price o pay for the advantages obtained. (I nclose a copy of Mr ——'s letter to ny company, as this gives some idea f what he found in practice.) It is ot fair to suggest, as Mr Rowe does, hat speakers must also be shielded, as his is certainly not necessary.

Mr Rowe: First I must correct Mr Sinclair in the interests of accuracy. If ou check my comments on p. 115 of he June article, you will look in vain or any statement that the transient reponse of the X-20 "will not be good." I restricted myself solely to commenting on the claims of extremely high damping factor for PWM amplifiers as a whole, and commented that the effective output impedance will be a rather complex function of switching waveform, the low-pass filter characteristic, the output transistors, and so on. To my knowledge no one has demonstrated that this is not the case.

Mr Sinclair's description of the filter inductor is a deceptive over-simplification. From a damping factor point of view the inductor is directly between the speaker (as generator) and, typically, a pair of less-than-perfect shorting switches alternating at a supersonic rate. As soon as one admits that the driving waveform and finite switching time of the transistors results in non-instantaneous switch-over, the impedance of the filter inductor immediately becomes relevant.

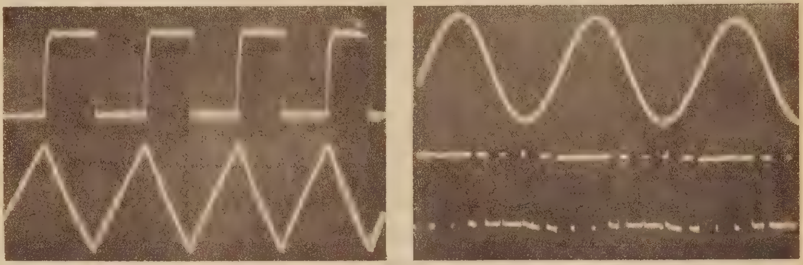
Quite apart from this there is the matter of AC saturation resistance of the output transistors and the resistance of the inductor itself.

Although I cannot refer to the transistor type used in the output stage of the X-20 (as I mentioned earlier, the type numbers are lacking on all transistors) a quick run through manufacturers' curves for high-current silicon NPN switches of the general type used revealed that few have an AC saturation resistance lower than about 0.7-0.8 ohm. If we add to this the approximate resistance of the X-20's series filter inductor —also about 0.7 ohm—we obtain the figure of approximately 1.4 ohm.

This figure is thus a fair estimate of the audio output impedance of an amplifier along the lines of the X-20, if we assume for the purposes of discussion that we have the **ideal** case of instantaneous switchover. In practice, this will not be achieved, with the result that the effective output impedance will be higher than this. As most readers will be aware, the figure of 1.4 ohm for audio output impedance is not particularly impressive, though it may be adequate. There are many linear amplifiers of both the valve and transistor variety which do better.

Mr Sinclair's reference to the equivalent circuit of a normal speaker seems to me to border on the irrelevant. With a normal amplifier the speaker does not look back into a pair of rapidly alternating switches, so that the problem does not arise; although the voice-coil impedance will obviously play a part in determining the final damping ratio, the amplifier cannot do more than present the lowest possible output impedance. The rest is up to the speaker designer.

In passing, Mr Sinclair seems indirectly to have suggested another disadvantage in the PWM case: the series voice-coil inductance will degrade the damping still further, as it is effectively additive to the filter inductance in determining the effect of non-instantaneous switch-over.



Oscillograms submitted by Mr C. M. Sinclair: At left, outputs from the square-wave generator and the integrator. At right, an input sine wave and the resulting modulated square wave.

With regard to the second paragraph I'm prepared to admit that I was probably a little over-zealous in suggesting that the speaker might need to be shielded. Shielding of the speaker leads would certainly seem to be imperative, but it may well be sufficient to ground the speaker frame as is usually done with car radios.

"9. When two PWM amplifiers are used for stereo, they can interfere with each other if the PRFs are different. But we provide instructions for coupling two X-20s together so that their PRFs are locked. This involves nothing more than a piece of wire and makes mutual interference impossible.

Mr Rowe: I must apologise; when writing the original article I must have looked through the X-20 booklet three or four times in search of any instructions along these lines, but searching through again I have just found the sentence to which Mr Sinclair refers. I wonder how many X-20 owners have failed to find it? It surely deserves more prominence.

"10. It is quite true that it is desirable to use high-frequency silicon transistors in the output of a PWM amplifier while germanium power transistors may be used in a class-B amplifier. We do this in the X-20. However, the difference in cost is slight, so this can hardly be termed a disadvantage.

Mr Rowe: I agree. However, by the same token, one is hardly justified in regarding it as a definite advantage, either.

"11. Mr Rowe suggests that there is a strong risk that speakers may be damaged by the high-frequency component from a PWM amplifier. Since the output choke limits the amplitude of the current at these frequencies to a few milliamps, this is a ridiculous suggestion. Even without the choke, no speaker could ever be damaged, because not only does the inductance of the speaker limit the current, but so does the rise of resistance with frequency caused by magnetic losses.

Mr Rowe: Although Mr Sinclair's certainty in this regard is reassuring, I wonder whether this fully answers the doubts of those who suggest this possibility. For example, there may be a risk of unfortunate resonances produced when tweeters are used in conjunction with crossover networks (although there is admittedly some doubt as to whether it is desirable to use such networks with the X-20 if output transistor damage is to be avoided). There may also be prob-

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ms with speakers having metallic voice-ıl formers.

Incidentally I note that Mr Sinclair akes no mention of the possibility of ng-term effects due to voice-coil disacement by unequal quiescent markace ratio.

"12. I must now come to the meaurements Mr Rowe made on our ampliɛr. I am afraid that his photographs ıow that he made some error in obtainıg these, so that the results he obtaind are completely misleading, not to say amaging to our reputation.

"I enclose some photographs we have ıst taken which show quite clearly 'hat the waveforms actually look like. 'he first photograph shows the outputs f the square wave generator and the ıtegrator. The second shows how the ıark space ratio of the output square 'ave varies for an input sinewave at 0KHz. It is necessary to use a high ıput frequency to make the variation lear on an oscilloscope and a rather ood 'scope is needed to lock to the igh-frequency signal. The picture clearly hows the very fast rise and fall times f the square wave.

"The third photograph shows the outut from the amplifier, again for a high ıput frequency, with the square wave or comparison. The fourth photograph hows a 30-volt peak-to-peak medium requency sinewave at the output across 15-ohm load. No additional filtering f any sort was added, although it is, of ourse, quite easy to filter the sinewave ompletely. It is not necessary to filter he signal completely before feeding the ignal to the speaker, because the peaker acts as a very efficient filter tself. The purpose of the filter choke s primarily to protect the output transisors from capacitive loads and to reduce adiation; not to protect the speakers. enclose a diagram showing how we nade our measurements, so that Mr Rowe may duplicate them if he wishes.

Mr Rowe: The oscillograms which Mr inclair encloses are certainly much etter than those which we obtained; ut as for ours being misleading, I eave the reader to judge.

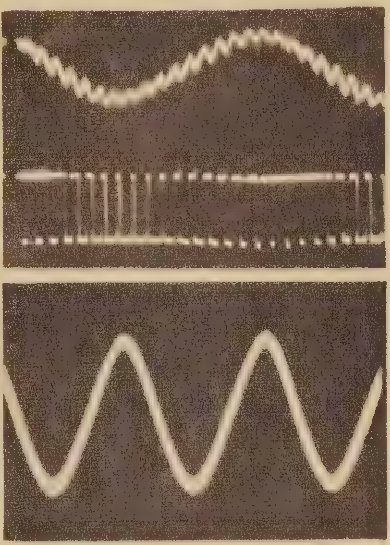
Our oscillograms were taken using a igh-quality 6 MHz oscilloscope and ve were guided by the small amount of nformation given in the X-20 booklet. Ve connected the amplifiers to a 33V ower supply as suggested, connecting a on-inductive 15-ohm load across the utput. To observe the output waveform ve did what one would normally do: Connected the oscilloscope across the utput load. And, to observe the other vaveforms, we left the oscilloscope arth connected to the output earth erminal and used a suitably compenated isolator probe. Fairly standard rocedure, I think most will agree.

In examining Mr Sinclair's diagram I oted two differences between his setp and ours. One is that a 0.68uF capacitor is connected across the power upply terminals right at the board; the ther is that a note stipulates that the oscilloscope should have a "floating" arth, and that this point should be onnected to supply negative—the amplifier's active supply line. Neither of hese points was hinted at in the X-20 ooklet, and I don't think that either vould be "the natural thing to do."

Yet when I modified our setup ccordingly — lo! All those nasty sproogles" disappeared from our vaveform. Tests showed that the proogles were, in fact, a ringing waveform at about 1.2 MHz which appears between the X-20's "input earth" and "output earth" terminals. The origin of this ringing is not clear.

The difference between the two sets of oscillograms is thus explained, although I am far from convinced that we were in error. The pity is that details of the "correct" testing procedure were not available when the amplifiers were submitted for review.

At the same time I find the presence of the above-mentioned ringing waveform rather disturbing. Even if we ignore its effect upon the apparent circuit waveforms, the question still remains as to whether it may affect circuit operation in other respects.


Two further oscillograms: At top, the output from the amplifier with high frequency input signal, and related square wave. At bottom, output from the amplifier at medium frequency and 30 volts peak-to-peak.

Incidentally, we still cannot obtain an output waveform with a supersonic component as small as that shown in Mr Sinclair's fourth oscillogram.

Note that Mr Sinclair draws our attention to the fact that his waveform is 30V peak-to-peak, and that this corresponds to a power level of 7.5 watts RMS. More about this in connection with the next point.

"Mr Rowe's criticisms of the performance of the X-20 on listening tests can again only be explained by assuming that he has made some mistakes in connection. Many thousands of X-20s are in use in England and, while they are undoubtedly slightly harder to connect up to than conventional amplifiers, we have had very satisfied reports on them. The distortion is quite certainly undetectable by ear at 12 watts output let alone the 0.5 watts mentioned by Mr Rowe.

"The stipulation about a lower supply voltage than we recommend was added by our Australian agent, who considered it necessary in view of the high ambient temperatures encountered in Australia.

Mr Rowe: Just to be sure I connected up our X-20 units again, in the manner prescribed. I added the 0.68uF capacitor across the power supply, made sure that only the input "earth" was grounded and had the setup checked. Listening tests, in which other staff members have participated, have again shown that audible distortion is evident on tone test at power levels of the order of 0.5 watts RMS.

Looking at the output waveform on the oscilloscope we **can** obtain an apparent audio component of about 28V peak-to-peak before clipping is visible, corresponding to 6.6 watts RMS; but the audible distortion at this level is most unpleasant.

Admittedly we are using the lower supply voltage recommended by the local agents, to be on the safe side. No doubt, if using the full supply voltage we would be able to obtain an apparent output of 30V peak-to-peak but I see no reason to believe that the distortion would be any less evident.

In any case 7.5 watts is hardly the 12 watts claimed in the X-20 literature and mentioned by Mr Sinclair above.

"13. Some of Mr Rowe's remarks regarding the X-20 manual unfairly give only part of the story. He criticises our statement which says that magnetic pick-ups may be fed directly into the X-20 as such pick-ups are self-equalising when fed into a low resistance. Surprising as it may be to Mr Rowe, this is strictly true, just as it is true that a crystal pickup may be equalised by connecting it into a high resistance.

"What Mr Rowe fails to mention is that we do not recommend this method for high performance pick-ups and that we give an alternative circuit for these which accords to conventional practice. The reason for this is that high performance pick-ups frequently have such low impedances themselves that the simple method would not work.

Mr Rowe: In "R, TV & H" for November 1961, p. 57, the writer examined in some detail the effect of low resistance loading of magnetic cartridges before proceeding to the design of a high-quality transistor preamplifier. As explained therein, low resistance loading under the most favourable circumstances provides only **part** of the required equalisation. To my knowledge there are no magnetic cartridges available in Australia at a price sufficiently low to justify the "near enough is good enough" approach.

(Continued on page 174)

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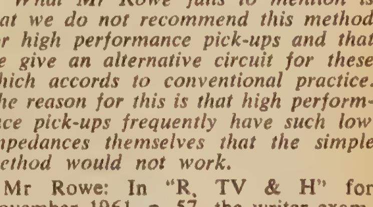

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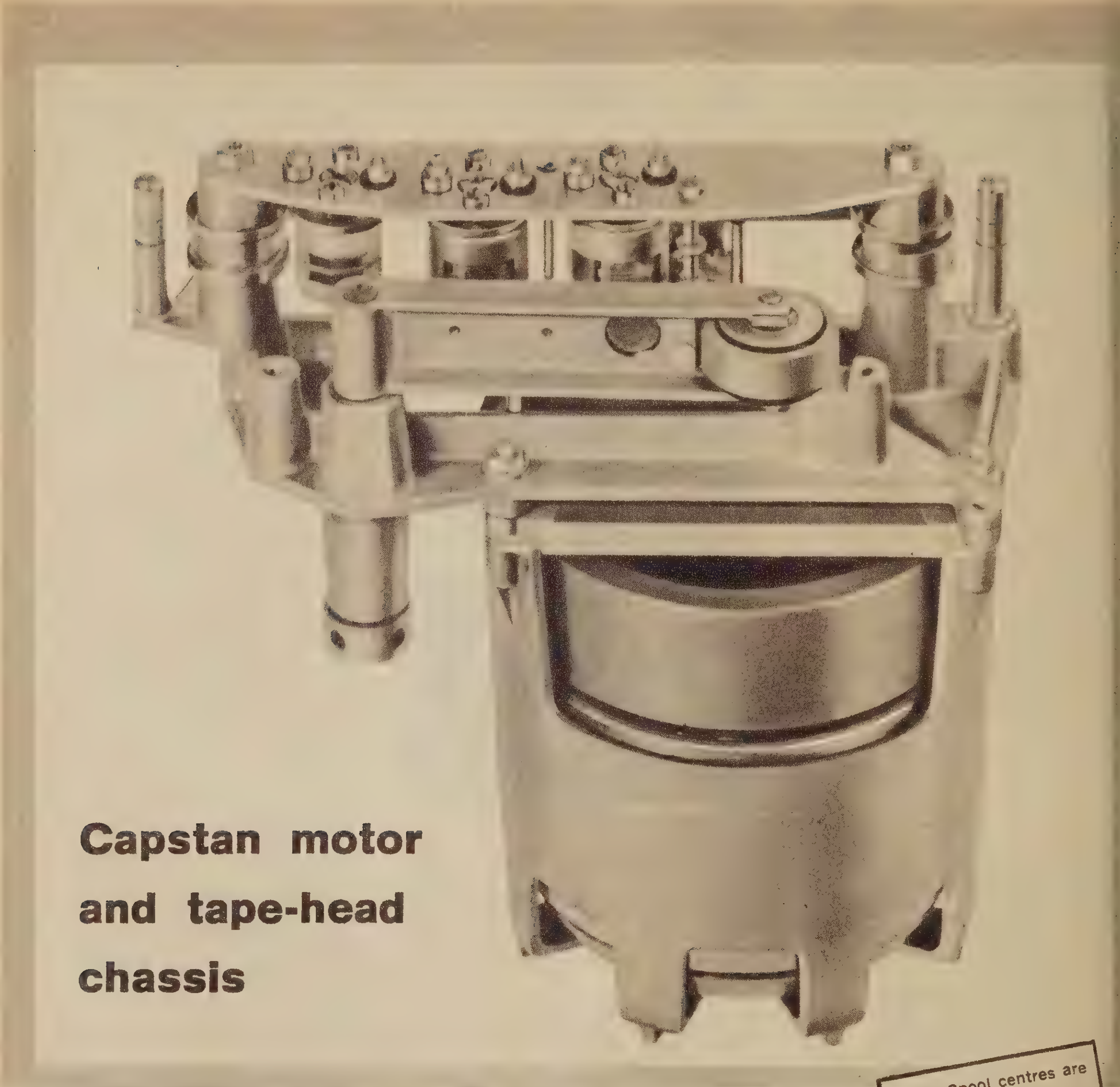

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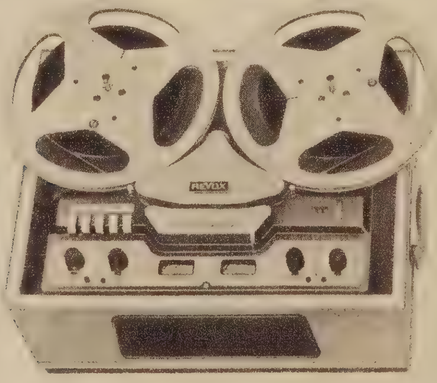

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KNOW YOUR GRAMOPHONE*

A plain man's guide to records and reproducers

By JOHN BORWICK, B.Sc.

PART TWO—HOW A RECORD IS MADE

Assuming that the musicians are asembled in the studio and have reearsed to the point of being note erfect, what technical operations are ecessary to turn their performance into gramophone record? Essentially, these tages are as follows:

1. The performers must be positioned the layout which best suits the microhones and studio.
2. The microphones must be positined for maximum fidelity in terms of nal quality of the individual instruents, balance between the parts and aturalness of acoustic ambience.
3. The recording engineer, under the irection of the recording manager, ust adjust the control console knobs nd switches so that his microphones lend to produce the best balance, and re frequency corrected, tinged with rtificial "echo" or controlled dynamially as may be necessary.
4. The resulting tape recording must ontain the performance complete with ny passages repeated as necessary to orrect musical or technical flaws.
5. The tape editor, as directed by the ecording manager and conductor, etc., ust cut out any flaws and splice the est "takes" together so as to produce e final master tape.
6. The master tape must be ansferred to a direct cut disc.
7. The direct disc must be processed that hard wearing stampers are prouced capable of turning out any reuired number of gramophone records – known in the trade as "pressings."

Let us, for this month's instalment, ke a quick look at each of the perations in so far as this helps us to nderstand the properties of the records e buy.

Where shall I sit? While musicians ill usually invite the recording engineer move them around as he pleases, the interests of getting the best sound nto the record, they are always happiest the traditional seating arrangements; ey can then hear the other instruments their accustomed perspective and auge the volume of their own playing ore confidently.

In the early days of recording, musians had often to be squashed up tother or isolated from one another to vercome the effects of insensitive icrophones or horrid acoustics.

Nowadays, it is a hidden bonus in e great technical advances of microones and studios that chamber ensemes and orchestral conductors may now ke up the same dispositions for rerding as for a concert. Conditions are therefore conducive to good rehearsal and performance.

Listening to a monophonic gramophone record (or radio broadcast) the whole of the sounds we hear now originate effectively from the centre of the loudspeaker (or some intermediate point in space if we listen to two or more loudspeakers).

We therefore have no sensation of "right and left" and the only clue we have that the musicians are not all in effect sitting on the same central chair is that they have different degrees of "aural perspective."

The first desks of violins, violas and 'cellos are closest to the microphone and so the direct sound picked up by the microphone stands in the greatest ratio to the general reverberant sound being reflected (after a transit time delay) from walls, ceiling, etc. This tends to give those instruments a closer perspective, while the more distant instruments naturally sound further away.

The art of arranging the performers for recording is to ensure that the change in perspective is neither too steep nor too flat, but just natural.

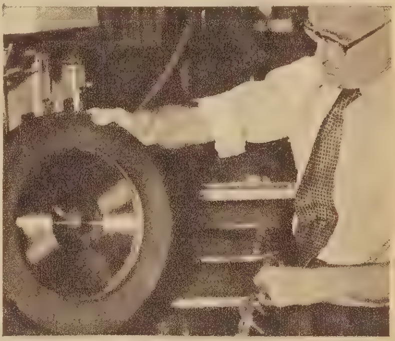
For stereo, there is also the question of distributing the performers so that they sound naturally disposed along the horizontal line between the two loudspeakers. This has led to the practice of marking out the studio floor in a chessboard pattern so that performers' positions can be noted from day to day and movements in opera can be planned in shorthand as "F3 to H5," etc., just like working out moves in chess.

An LP record being taken off the press, with label in position. The rough edge will be trimmed and polished.

The studio acoustics are usually less predictable than one would like, however, and all such positions and moves have to be tried out "on the day" and the effect listened to on a pair of loudspeakers spaced about 10ft apart to simulate the listening situation of the eventual record buyer.

How many microphones? Ideally, one would expect to use a single microphone for a mono recording and two for stereo. This would give the purest sound quality, permit a natural layout of the players and give them and the conductor a feeling of confidence that the internal balance of musical parts was being faithfully preserved. Unfortunately, except in a few halls or studios and where the musical forces being employed exactly match the environment, this ideal is hard to achieve.

The recording engineer then resorts to a multi-microphone technique and is occasionally criticised for doing so. In fact, most of this criticism is unfounded and an experienced engineer can run out a dozen or more microphones and still produce an integrated recording that is superior to the "one-microphone" sound obtainable in the given circumstances.



The quality of modern pressings depends heavily on plating techniques as, for example, in the production of this matrix at the EMI factory at Homebush, N.S.W.

After all, the desired sound is clear enough in his head (and that of the recording manager, conductor, etc.): how this sound is captured on the final disc is simply a question of technique.

The control room: Lengths of cable connect the microphones to a control desk which is normally installed in a room soundproofed from the studio but giving visible access through a double-glazed window.

This independent monitoring of the sounds being picked up by the microphones is essential and each microphone has an individual fader knob so that the effect of each can be gauged and the mixture carefully adjusted for optimum balance as heard on the loudspeakers.

The overall sound level is carefully monitored too—by ear and meter—to make sure that the dynamic range is as wide and as faithful to the original as possible.

*** Reproduced by arrangement with "Gramophone" magazine.**

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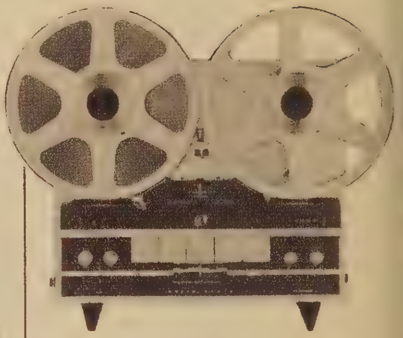

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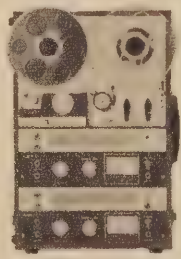

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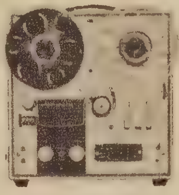

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Until about 15 years ago, it was the practice to record on disc, cutting master discs as the rehearsal/recording "take" schedule progressed. But setting up the cutting machines for each disc was a critical and time-consuming operation which made it difficult to accommodate the inevitable false starts, retakes and technical hitches of a normal recording session.

Magnetic tape machines are easy to line up and, even at the relatively high tape speeds of 30 or 15 inches per second used to obtain high quality, can cope with "takes" lasting from a few seconds up to half an hour. Indeed, by overlapping machines, continuous recordings of any duration can be made.

A secondary property of tape is that it allows a number of tracks to be recorded simultaneously—say eight tracks on one-inch wide tape. These tracks of course remain in synchronism and the novel prospect is opened up of recording the outputs of various microphones or groups of microphones on separate tracks and postponing the final mixing operation to a later date.

One could even record without some of the performers and add their tracks later!

Naturally this piecemeal method of recording is anathema to the serious musician, since it prevents a concerted, unified performance. But it is resorted to in isolated cases and is standard practice in the pop recording world and in some light music.

Artificial echo is another gimmick or echnical trick which has come in for criticism. Here again, however, used sensitively this ability to brighten the apparent acoustics of a studio, by adding reverberation from a bare room or vibrating plate, is a quite legitimate recording tool.

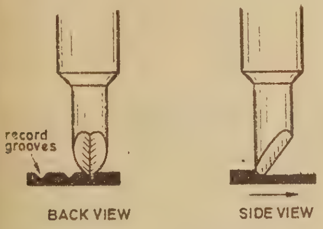

Figure 1: Showing the back and side views of a cutting stylus.

Tape editing: Once every note has been safely recorded, together with any epeats or corrections, the real advantage of tape becomes apparent—the ease with which it may be cut and spliced ogether.

The first thing that happens is that he recording manager arranges a listening session with the conductor or artists t which the best of any alternative takes" are selected. Details of these are marked on a cue sheet and orchestral core and passed through to the tape ditor who, armed with the score, splices he selected passages together to produce he final complete master tape.

Editing music tapes is a highly skilled ob and, since many of the joins will be at the end of a phrase where a cut in studio reverberation or sustaining edal will stand out for all to hear, ny slight slip is liable to show. The wonder is that so very few instances of vident tape joining occur.

Transfer to disc: When the master tape is assembled and passed, it is then transferred or "dubbed" to disc. Operation of the cutting lathe and associated gear now tends to be fully automatic so that the lead in, lead out, finishing and banding grooves are programmed beforehand. The pitch or spacing between grooves is greater at these points, of course, which means that the speed of the motor driving the lead screw carrying the cutter carriage across the disc has to be accelerated at the right moments—and arrested altogether for the finishing groove which completes a circle.

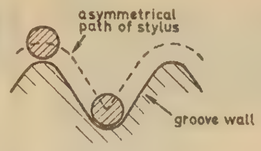

Figure 2: Tracing distortion due to the sound reproducing stylus following a different path from the cutter tip.

Fine control of the lead screw velocity, in an invention by Mr Arthur Haddy of Decca, has produced the technique known as variable groove recording. This makes more economical use of the recording area by moving the grooves closer together during quiet passages (less side-to-side amplitude in the recorded waveform) and spacing them further apart to accommodate loud passages.

The secret lies in the use of sensing heads on the tape replay deck which scan the tape at a distance equivalent to one revolution in front of the reproducing head proper. They collect advance information as to the nature of the recorded amplitude, frequency and vertical-lateral distribution (in stereo) of the signal.

This information is automatically used to vary the groove spacing and even the depth of cut. Marked improvements in dynamic range and playing time per side have resulted.

The quality standards maintained during the transfer from master tape to master disc are now phenomenal. Only a few years ago a detectable difference existed between the tape and off-disc signals.

Now, as I have found to my cost, it is fatal to place a small bet on one's ability to distinguish between the signal going into a disc cutting machine and that reproduced by a high quality pickup tracking just behind the cutter head.

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5D7M	2400' .5 Mil Polyester	9.30	4.65
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5D7MS	3600' .48 Mil Polyester	15.90	7.95
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GREEN CORPORATION LTD. 88 KING ST., SYDNEY. PHONE 25 198 ality of discs is the use of feedback fectively from the cutting stylus to an rly stage in the recording amplifier. is has made it possible to minimise e variable effects of the lacquer disc aterial itself and enabled the cutter re- onse to be maintained within ± 1 dB om 30 to 15,000Hz in some cases.

Stylus contours: An inherent limit is t to the accuracy with which a gramo- one pickup can trace the recorded aveform by the differences which must ist between the shapes of the styli ed for recording and reproducing re- ectively.

The cutter head stylus has a flat chisel ape (see figure 1) so that it will cut t a clean furrow—the material re- oved comes away in a long, continuous read known as swarf and is removed air suction. In fact, the cutter stylus bevelled and so the groove walls have hedge of extruded material on each le.

To reduce wear on reproduction, the ckup stylus must be rounded and, ex- pt for developments in elliptical tips, e traditional contour is hemispherical. etty obviously, the stylus cannot ex- ore and therefore reproduce a groove ose curvature is finer than the tip elf.

An upper frequency limit therefore ds to be set, since higher frequencies rrespond to smaller wavelengths, and is limit reduces towards the centre of e record as the wavelength is pro- essively shortened due to the fall in ear speed (see last month).

The high frequency losses are less if fine tip radius is used, but distortion st inevitably arise as shown in figure since the stylus path is non-symmet- al and in any case different from that the cutter stylus. This gives rise to at is called tracing distortion. Figure illustrates a mono groove and a related m of distortion known as pinch effect. though the cutter vibrates always at ht angles to the groove and may be ten to cut a groove of constant width, effect on a spherical pickup tip is to oduce unwanted, spurious up and wn motion.

This is because the spherical tip “sees” wider groove at the apex of each half cle but a narrower groove at points in tween. The tip is therefore pinched d will tend to ride upwards twice per cle. The result is a tendency to in- ase record wear. needle talk and the oduction of a note at twice the re- rded frequency (second harmonic dis- tion).

To be strictly accurate, this distortion ll be important only with pickups ich respond electrically to vertical otion as when a stereo pickup is play- a mono record and not switched for ono” reproduction.

Record pressing: For the next stage record processing, the direct disc re- ding is submerged in an electro- ting bath and a copper Master is own” on to it (see figure 4). When led off, the Master is a copy of the c in reverse, with ridges instead of oves, and could be used for pressing records of some suitable plastic terial.

However, since it would soon wear , the plating process is twice repeated as to produce first a Mother (with oves like the original) and then a trix or Stamper which is given a d chromium plating and used for the ual job of pressing out records.

When a Stamper is in any danger of wearing out, further Stampers may readily be produced from the Mother.

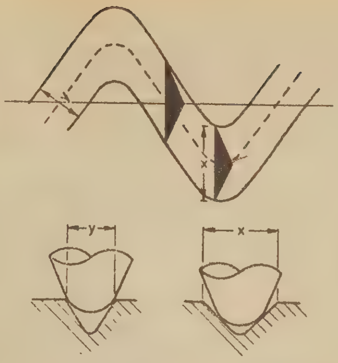


Figure 3: Pinch effect occurs due to the fact that the wedge-shaped cutting stylus produces varying groove widths x and y as seen by a round reproducing stylus.

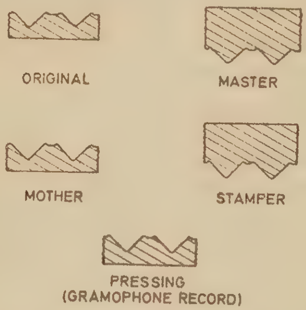


Figure 4: The stages in processing a gramophone record.

After finding where to drill the centre hole in the Stamper, which is done by reference to a concentric line cut on the outside of the original disc for this very purpose, the Stamper is then placed in one jaw of a hydraulic press and the Stamper which will produce the other side of the record is placed in the other jaw.

Then, oddly enough, the two paper labels are put in position and the plastic record material in the form of Geon chips or a tarry-looking “biscuit.” The heated jaws then close to plasticize and press out the material, then are rapidly cooled and opened.

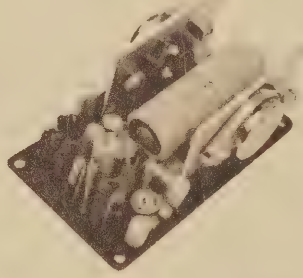
There is a fuzz surplus material round the disc which is roughly cut away and then the edge is buffed smooth on a rotating machine. The disc is then ready for placing in its envelope and packing as the first stage in its journey to the customer.

To sum up our progress so far; we have briefly looked at the way gramophone records evolved and are made, and we have taken a sideways look at some of the inherent distortions on the way. Readers may at this stage be feeling that the distortions are too numerous to overcome. But the fact remains that modern gramophone records can give us the best sound reproduction available today.

Next month we shall begin our study of the links in the reproducing chain by talking about the construction, setting up and operating of gramophone turntables.

(To be continued)

SINCLAIR



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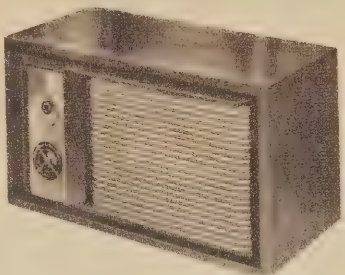

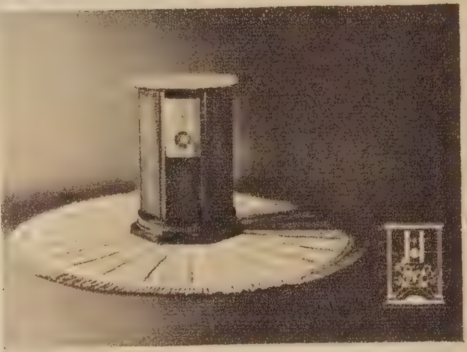

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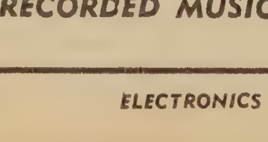

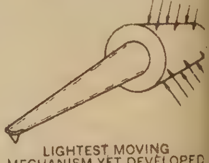

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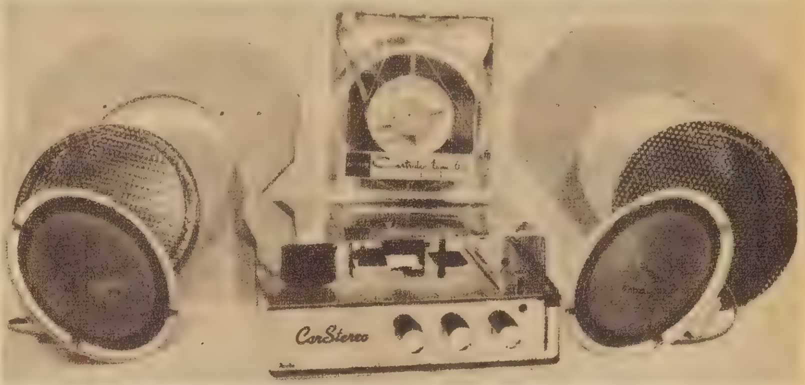
STEREO TAPE PLAYER for CARS

The equipment pictured was sent for our interest and inspection in response to the Editor's article in the July issue reviewing overseas stereo tape systems for cars. Manufactured in Japan by the Taiko Electric Works, Ltd., the system is fully transistorised and accepts four-track tape loop cartridges of the "Fidelipac" type. It was forwarded by the Australian importers, Wholesale Appliance Distributors Pty. Ltd., of 304 Logan Road, Stone's Corner, Brisbane.



The Taiko Car Stereo tape system, with player unit, two speakers, baffles and a sample tape cartridge.

The Taiko "Car Stereo" tape player is the first of these units to reach our laboratory, and was certainly of interest in view of the current American activity in this field as reported in trade journals. It may well be the first unit of its type to appear on the Australian consumer market, in which case it could conceivably initiate a similar trend in this country.

Heart of the system is the player-amplifier unit, measuring about 10in x 9in x 3½in overall and provided with a generous set of mounting hardware to permit a variety of mounting arrangements as dictated by the space available and the taste of the purchaser. The finish is in the material traditionally espoused by Detroit as "the obvious choice" for all auto accessories: chrome plating.

Even the plastic control knobs are chrome-plated, although with only limited success if one is to judge from hose on the sample. Already two of hese are showing distinct signs of blisering and peeling, although this is admittedly a minor point of criticism.

The deck surface which receives the ape loop cartridge has a pair of cartidge location fingers and a guide fence, ogether with a spring shoe which clamps the cartridge in place. Gaps in he cartridge permit the tape to contact he magnetic head and the drive captan, while the pinch roller swings up nto place through a hole in the underide of the cartridge when the "on" lever switch is depressed.

The design of the "Fidelipac" cartidge is carefully arranged so that once he pinch roller has swung up into operating position, the cartridge is locked in position. It can only be removed after he switch lever is depressed a second ime to switch off the motor and amplifier; thus the tape is protected from amage due to cartridge withdrawal with the pinch roller in position.

The unit will accept cartridges up to ¼in wide, and operates at 3¾ips. It as a ¼-track head which is shifted mechanically to align with the approriate pairs of tracks.

The amplifier is fully transistorised and has push-pull transformerless output stages in each channel. It is provided with ganged volume and tone controls, together with a full range balance control. Speaker and power connections to the unit are via a five-pin plug at the rear, together with the earth return via the frame. The sample unit was a 12V positive earth system, and was provided with a 1.5A line fuse.

The speakers which accompany the unit are single-cone 6 inch 8-ohm types of modest quality. They are provided with small pre-cut wooden baffles and alternative grille materials, together with connecting leads fitted with rapid auto-type connectors.

Tested in the laboratory, the system sounded quite impressive. Wow and flutter are quite low, and reproduction seems commendably unaffected by rapid movement of the player in any direction. Although a small amount of motor whine is audible both mechanically and in the speakers with the volume turned full up, this is inaudible with the music playing at a typical listening level.

With the speakers provided with reasonably effective baffling, the reproduction should thus be of quite high quality. Not as high as one would expect from a home system, to be sure, but more than adequate for the purpose intended.

The sample tape cartridge supplied with the unit featured "Jazz Highlights" from anonymous performers, and could hardly be said to constitute the soothing type of background material which one might expect to be most suitable for this application. In particular its wide dynamic range would make it a little unsuitable for the fairly noisy environment provided by a car moving in traffic. However, the tape may possibly be one intended mainly for demonstration use, and we understand that a choice of programs is available.

The only real criticism we might offer is that the system is not provided with installation instructions. The sample unit was without even an owner's operating guide booklet. Considering the price of the unit this seems a rather unfortunate omission.

And the price is somewhat higher than you'll pay for even a high-quality car radio—$150.80. (J.R.) ◘

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Classical reviews

By JULIAN RUSSELL

Daphne" - a Strauss Masterpiece

CHARD STRAUSS — Daphne. Complete Opera. Paul Schoffler (Peneios); Vera Little (Gaea); Hilde Gueden (Daphne); Fritz Wunderlich (Leukippos); James King (Apollo); Hans Braun; Kurt Equiluz; Ludwig Welter and Harald Proglhof (shepherds); Rita Streich and Erica Mechera (maids). Vienna Symphony Orchestra conducted by Karl Bohm. DGG Stereo 138 956/7.

Daphne was finished in 1938, late in career of its prolific composer. Yet shows no startling or even minor de- opment of his style of writing of ny years before. For Strauss's music, student works behind him, changed raordinarily little in his long life de- ed to composition. He made some ly efforts to rid himself of post-Wag- ian traditions — in Salome, Elektra Die Frau Ohne Schatten. In these added different, and often strident, sonances to the chromaticism of stan. For a while he was the "enfant rible" of the music pre-World War I, he soon relapsed again into "re- tability" with nothing more than a nce at the work of Schonberg and his ciples.

Strauss was one of the greatest com- sers for orchestra that ever lived. By t, however, I do not mean greatest hestral composers. But I do mean t his scoring was always highly ginal, sometimes echoically ingenious, despite the very large resources he quently deployed, always sympathetic singers, especially sopranos and con- tos. Commenting on his quite extra- inary skill in making the orchestra jure up non-musical sounds — the ating of sheep in the tone poem "Don ixote," is one example — he once isted that he could describe a glass beer in music.

'Daphne" shows Strauss at the height his powers, mellowed by maturity. It tains no violent dissonances, no ex- vagant orchestral or vocal gestures. eed its plot is singularly without pic- esque incident, and even the bacchan- he includes for purely theatrical ct sounds very tame when compared the eroticism to be found in Salome the tone poems. Yet its score is laggingly melodious, gut together by astmaster of his craft, and the opera, watch, is extraordinarly gratifying.

was particularly interested in this because, with one exception, the cast the main roles is identical to that I rd in Vienna last year. By the way, German or Austrian should speak ou about Daphne, which I, and prob- you pronounce in the English fash- you may wonder for a while what is talking about. He will call it, as rly as I can spell it in English, rffner." The Vienna production was by Rudolf Hartman, the director of the Munich State Opera, and probably the finest Strauss producer in the world. It is his production that has been recorded here.

The story of Daphne is taken from Greek legend of the woman Apollo turned into the fragrant shrub that still bears her name. It is without exciting incident; the conflicts between the characters break out only once into violence — where Appollo slays Daphne's mortal lover, Leucippus, with what is reminiscent of Wotan's contemptuous despatch of Hunding in the Valkyrie, but with, of course, the accompaniment of quite different music. The most effective bit of theatre is reserved till right at the end where, in the Viennese production, Daphne, standing motionless, was before my eyes transformed into a tree in one of the most convincing illusions I have ever seen even in the old-time magic shows of such illusionists as Maskelyne and Devant. This scene is accompanied by some of the loveliest music Strauss ever wrote, music of a refinement and mystical quality never met in his earlier works.

DGG, in their operatic sets, seldom issue an accompanying libretto, only the story of the opera, with much in the way of comment included in their otherwise impressively produced books. But the plot of Daphne is so easy to follow that in this instance, a libretto is not missed.

Strauss was one of the best composers for the female voice who ever lived but was less sympathetic to male singers, especially tenors, whom as a general rule he disliked. The tessitura of the part of Apollo is unusually high and one feels that James King, despite a radiant clear voice devoid of heldentenor tricks, is constantly under strain. But despite these difficulties he manages here, as he did in Vienna, to give an eminently acceptable account of the role, The second tenor, Fritz Wunderlich (Leucippus), is more considerably treated and emerges unscathed and musical from the ordeal.

The dignified old shepherd Paneios is admirably performed by bass Paul Schoffler.

The Daphne, Hilde Gueden, offers a fresh-voiced reading of the part which emphasises the youthfulness of the character. She is undaunted by high top notes and comfortably colourful in the middle and low register. On the other hand Vera Little as Gaea—this is the only major change from the Vienna cast, where I heard Hilde Rossel-Majdan in the part—surprisingly, for a contralto, is less comfortable in her lower register than in the higher where, however, she makes considerable amends. Rita Streich and Erika Mechera as the maids are always light, bright, but never, thank heavens, arch.

Strauss dedicated the opera to Karl Bohm, who conducted the first performance, and here directs the Vienna State Opera Orchestra and Chorus in a reading that is equally at home in the lighter scored chamber-opera passages as in the more fully orchestrated sequences. The whole score is an encouraging example of the amount of beautiful music that can still be written diatonically. You have only to play the opening bars, the lovely Daphne tune, to realise what can still be conjured, by a master, out of the notes of a simple major scale.

Contemporary Music of France

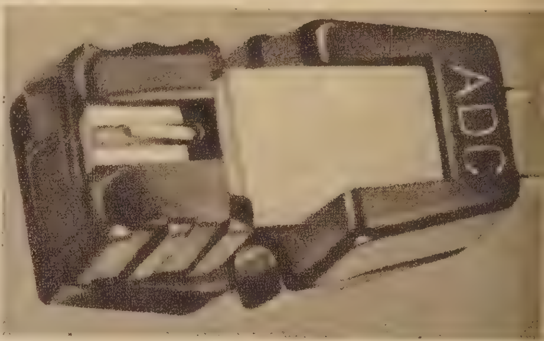
MUSIC TODAY (Volume 3). Recorded under the auspices of the Gulbenkian Foundation. Koechlin—Les Bandar-Log. B.B.C. Symphony Orchestra conducted by Antal Dorati. Boulez—Le Soleil des Eaux. Josephine Nendick (soprano); Barry McDaniel (tenor); Louis Devos (bass); B.B.C. Symphony Orchestra and Chorus conducted by Pierre Boulez. Messiaen—Chronochromie. B.B.C. Symphony Orchestra conducted by Antal Dorati. Record Society Stereo S/6189.

This, in terms of content, is the most important of the series yet issued, containing as it does works by two of the leaders of the avant-garde school, Boulez and Messiaen, and a lesser known but still significant French composer, Koechlin. The last has been till now unrepresented in the English gramophone catalogues, yet he did much to influence the trend in French post-Debussian music. It is therefore all the more surprising to note that he was born as long ago as 1867—only two years after the first performance of "Tristan"—and though he lived an active creative life almost up to the time of his death in 1950, very little of his music is on disc.

This period spans the development of French music from the academicisms of Saint-Saens, through Debussy, Ravel, Les Six, other petits maitres of the 30s and 40s right up to the early works of Messiaen and his pupil Boulez. His output was vastly eclectic, but whatever his sources, whether baroque, atonal, 12 tone or Debussian, he left a strong personal imprint on every score he produced. He was the first French composer to pay serious attention to the works of Schonberg and his disciples, and he had quite wonderful perception in sifting the gold from the dross in the works of their many disciples and imitators. His memory must have been prodigious for, according to the sleeve notes, while engaged on writing a treatise on orchestration, he wrote out from memory, passages from Schonberg's one-act opera Erwartung.

His ability to discern the meretricious from the significant in avant-garde works is brilliantly advertised in his composition included in this impressive disc, where he is represented by "Les Bandar Log," based on one of the tales in Kipling's "Jungle Book." He uses

THE CRITICAL HIGH FREQUENCIES



Clean reproduction of highs depends on low effective stylus mass and this means low inertia of the cartridge's moving system. The stylus mechanism with the lower inertia can accelerate and decelerate faster and will negotiate more effectively the violent changes of direction of the high audio frequencies, which have extremely steep wave-fronts. At the highest audible frequencies the moving mass is accelerated (and decelerated) several thousand times the force of gravity!

With the advent of stereo, the moving magnet cartridge has proved to be one of the most successful breeds and there appear to be more makes and models than any other type. Audio Dynamics was indeed amongst the first of these designs and in 1960 they delivered tl ADC-1 (and later on the ADC-2 and ADC-3), which was a moving magnet playback head, BUT WITH DIFFERENCE. The difference was, that these cartridges had an extremely high compliance and a co siderably lower effective stylus mass than competitive brands, which could be attributed to a unique gyr suspension of the armature mechanism and the use of lighter materials both for the magnet and the movi parts. Success was immediate and quite extraordinary and audio authorities praised this advanced desi unanimously and very enthusiastically.

Whilst ADC engineers considered the moving magnet generating system an excellent compromise th also realised that it presented problems difficult to overcome. Moving magnets are relatively heavy—irre pective of shape and materials used—and a fairly long cantilever (stylus arm) is necessary to place both pol of the magnet between the pole faces in the cartridge body in order to obtain reasonable efficiency.

A significant further reduction of moving mass was achieved late in 1963 by another major step fc ward in the art of pickup design, THE INDUCED MAGNET PRINCIPLE. Immediately upon their i troduction to the world market the new series employing this principle made a terrific impact and sales figur and populartiy have truly been amazing. The experts' ratings leave little doubt and here are just a few quot from leading international high-fidelity publications, which refer to the reduction of moving mass made pc sible by this entirely new design concept.

AUDIO (U.S.A.).: "A distinct improvement over preceding cartridges made by this company, which we also quite excellent. The method whereby the stylus mass is reduced is quite ingenious."

THE AMERICAN RECORD GUIDE (U.S.A.): "A strong jump up from that company's previo moving magnets, which were themselves sonic advancements."

THE GRAMOPHONE (U.K.): "The effective mass as seen by the stylus is about as small as it coul possibly be."

HI-FI NEWS (U.K.): "The use of a fixed magnet, separate from the moving system, liberated the styl bar, which no longer has to carry the moving magnet."

AUDIO AND RECORD REVIEW (U.K.): "To achieve a considerable reduction of stylus mass, AD engineers developed a new series of cartridges."

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Kipling's noisy monkey tribe to shatter ne jungle silence with plagiarisms of Debussy and non-tonal music. Having rought this off brilliantly he goes on to how how such influences can be used y a master to produce music that, what-ver its origins, remains vitally inventive nd beautiful.

To achieve this he used a technique hat displays complete mastery of every spect of the orchestral medium allied) an enviable fertility of melodic in-ention. But don't mistake my enthusi-sm for encouragement to think that you vill find it easy going the first time hrough. Even then you will hear pas-ages that are immediately attractive, ut you will need further playings to eveal beauties that grow on one with ach repetition.

Boulez is represented by a setting for oices and orchestra of two poems by Rene Char, a Provencal poet who has rovided Boulez with many texts for nusical setting. This is a fairly early vork (1948) but already displays evi-ence of the composer's strong indi-iduality, despite his debts to Debussy nd Ravel. The first, Complainte du Lezard Amoureux has shining trans-arency in the scoring, and a vocal line hat reminded me of Ravel's in L'Enfant t les Sortileges, despite the often vast istances separating the sung intervals.

The second, La Sorgue, had a close ersonal interest for me since it des-ribes the river that gushes out of a lack rocky base at the Fontaine de 'aucluse, a short distance from Avig-on, where I spent many delightful days 1 1962, and from which stream came ne best trout I have ever eaten in my fe. The first piece is enchantingly sung y soprano Josephine Nendick, the sec-nd by a predominantly male choir, eautifully trained in the best French adition. Although this, too, might pre-ent problems to even advanced lis-eners at a first run through, it will also rove generously rewarding on better cquaintance.

Messiaen's contribution is perhaps the nost significant yet to be recorded by ne Gulbenkian Foundation. It com-ines the composer's extensive use of ird calls, many of them zet down in uite wonderful polyphonic splendour, vith percussive rhythms of startling itality that makes the listener's pulse hrob in a way that has not happened) this one since he first heard Stravin-ky's Le Sacre du Printemps. It was set own for performance by Gielen and ne Sydney Symphony Orchestra in July ut had to be abandoned because of the iability of the percussion department to andle its complexities. When you hear ne work you might well sympathise ith the poor fellows confronted with ich music to be played at sight — or ven after much practice.

Here, then, is the third of a most istinguished series, offered to the pub-c at a budget price, and without which obody's library, if they are interested 1 contemporary music, will be com-lete. I look forward eagerly to the ourth and last. You will also find much f the greatest possible interest in the uminating notes that accompany each sc.

* * *

HOPIN—Scherzo No. 4, Op. 54; Nocturne, Op. 62, No. 1.
EBUSSY—L'Isle Joyeuse.
AVEL—Gaspard de la Nuit. Vladimir Ashkenazy. Decca Stereo SXL6215.

Nowadays one has ceased to marvel the formidable techniques of many of the younger generation of pianists. Their brilliance is taken for granted. But few can make this virtuosity the complete servant of a mind of the musical sensitivity of Ashkenazy. There have been two other fine recordings of the Ravel suite, one by Gieseking, the other by Casadesus. Both have long been deleted from the catalogues here and abroad. This makes Ashkenazy's performance all the more welcome, since it can more than hold its own with those of the two great artists mentioned above.

The quite wonderful detachment of notes in "Ondine," a water sprite beckoning in the form of raindrops on a windowpane, makes every one of them glisten. Ashkenazy achieves a truly enchanting picture of a musical fairyland. The second piece, Le Gibet, describes a corpse hanging on a gallows in a deserted countryside. One note, repeated throughout the piece in nearly every bar, evokes the tolling of a distant bell. The landscape is as lifeless as the corpse. Under Ashkenazy's magic fingers just the right static atmosphere of the macabre is established at once and successfully maintained throughout this fine piece of descriptive writing.

Up till the time Ravel wrote "Scarbo," the third item in the suite, Balakireff's "Islamey" was considered the most difficult piece ever written for piano. Ravel set out deliberately to make his composition still more difficult. But one would never think so when listening to the ease with which Ashkenazy handles its many complexities. The notes seem to lie so easily under his fingers that he has no difficulty in decorating his interpretation with expressive rubatos and tonal nuancing. It is a performance that literally leaves one breathless with appreciation.

Ashkenazy in his first recordings showed himself to be a Chopin player with few rivals. He sustains this impression in his exquisite performances of the short recital on this disc. There is nothing effeminate in his Chopin. It is at once masculine and patrician. He can ring many delicious changes on sonorities while confining them to what has become known as the "Chopin touch." His runs are cream smooth, his phrasing elegant. And the same might be said of the Debussy piece with which he concludes a recital as impressive as it is entrancing.

* * *

SCHUBERT—Symphony No. 9 in C (The Great). Halle Orchestra conducted by Sir John Barbirolli. HMV Stereo ASD2251.

This is a big reading of a big work, but one which never allows the effect to become diffuse though the music is always given plenty of time to make its impact of charm. It can be successfully compared to the best recordings available today, and might be preferred by many to most. Barbirolli has his own ideas about tempos though where they differ from the most orthodox they are never freakish and remain undeniably valid. He is in frequent disagreement with those used by Bruno Walter and Otto Klemperer, less so with Karl Bohm.

Yet the lyrical spirit of Schubert is never absent. The fast passages display no unseemly hurry, the slow ones never drag. And the playing of the Halle, which has suffered an eclipse during recent years, now seems once again firmly established among, if not the four or five world's best orchestras, at least well up with the next level of orchestral excellence. The engineering is good though not outstanding. But this is less important than one might think since Schubert's orchestral palette, though never less than efficient, was fairly modest. Some uncertain horn playing at the beginning of the Finale could, one might be excused for thinking, have been corrected at a later take.

* * *

SCHUMANN—Symphony No. 3 in E Flat (Rhenish), Op. 87.
MENDELSSOHN — A Midsummer Night's Dream Overture. Op. 21. London Symphony Orchestra conducted by Rafael Fruhbeck de Burgos. Decca Stereo SXL6213.

Not even the great London Symphony Orchestra sounds altogether comfortable in the headlong tempo at which Fruhbeck sends the Midsummer Night's Dream Overture along. Of course, it should go fast. But at Fruhbeck's pace it tends to lose some of its fairylike atmosphere. True, there are many moments of delight in which the listener is tense with admiration for the skill of the players. But the operative word is tense, and that emotion is alien to the delicate charm of Mendelssohn's writing.

On the other hand, the Rhenish Symphony of Schumann receives beautifully warm and grateful treatment all through. The first movement flows just as a description of the Rhine should, and if the Scherzo sounds just a trifle hard driven, well, I know of no other way of making it sound like a Scherzo. Perhaps the most impressive movement of all is the fourth, inspired by Cologne's magnificent cathedral. Here Fruhbeck evokes a picture of true grandeur, while at the same time balancing his orchestra so that the scoring is often reminiscent of an organ-like polyphony. The Finale is becomingly sumptuous, despite instrumentation which, to put it kindly, is never in the first rank of good orchestral writing.

* * *

TCHAIKOWSKY—Romeo and Juliet; Hamlet. Tone Poems. Vienna Philharmonic Orchestra conducted by Lorin Maazel. Decca Stereo SXL6206.
TCHAIKOWSKY—Symphony No. 2 in C Minor, Op. 17 (Little Russian). Vienna Philharmonic Orchestra conducted by Lorin Maazel. Decca Stereo SXLA6162.

Maazel's cool-headed brilliance is not an ideal quality in the presentation of Tchaikowsky's music. It calls for more abandon, for more personal involvement than Maazel seems prepared to give it. Nor can there be any entirely successful half measures. Tchaikowsky demands total commitment, and when it is absent his music suffers accordingly. Thus even the love theme in Romeo and Juliet, surely one of the greatest melodies ever written, and correctly shaped by Maazel, still falls short of its full measure of emotional extravagance.

Where Maazel shines is in the clashes of combat—though even here one soon tires of the close-up cymbals—and the more athletic reaches of the score. And, remembering that it is the Vienna Philharmonic that he is conducting, an almost total lack of schmaltz hangs surprisingly over the whole enterprise.

Hamlet is, on the whole, treated a little more sympathetically, but then it

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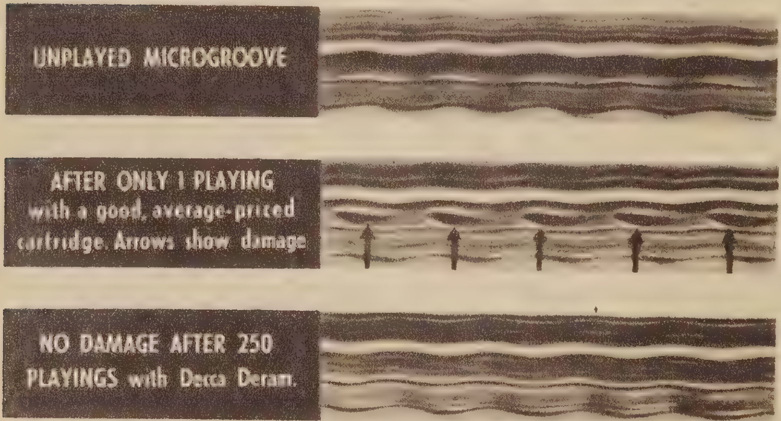
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lacks in the music itself the emotiona
drive of Romeo. It is seldom heard an
though closely modelled on its mo
popular fellow tone poem contains th
germs of disappointment to be found i
most repeats of a previously successfu
formula. By the way, you will, if yo
are like me, find it almost impossible t
identify the various incidents in the pla
with corresponding musical passage
When Elgar wrote his fine tone poe
Falstaff, the English critic Donald Tove
was able, before the program was pub
lished and from the score alone, t
identify most of the composer's descri
tive passages correctly. I wonder how h
would have got on with this version o
Hamlet?

Maazel, using the same orchestr
takes a similar almost non-committ
attitude to the Second Symphony. Tru
he manages to instil plenty of excite
ment into the many vigorously rhythmi
sequences, so that it is the Scherzo tha
emerges as the best movement. But th
more luscious moments are only seldo
moving and one recalls nostalgicall
Beecham's old recording with all i
panache.

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piano works close to an end. It is on th
same level of excellence as its predece
sors and Katchen deals gracefully, thoug
when necessary, forcefully too, with th
lighter type of composition.

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of the world's finest Chopin exponen
The waltzes played here confirm th
And the other pieces are all played
a manner that underlines the world's lo
at the premature death of this essenti
ly gentle artist.

★ ★ ★

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Op. 30, No. 2.
No. 10 in G Major, Op. 96.
Fritz Kreisler (violin) and Franz Ru
(piano).
World Record Club Connoisseur S
ies. Mono CE/3038.

This disc will appeal to the musicol
gist rather than the general public. Tra
ferred from 78s, the sound would n
pass muster nowadays. And some
Kreisler's stylistic mannerisms thou
popular during his career, are now
considered quite the thing. Howev
musicians whose 78s have long sin
worn out might like to have the p
formances in this handy form.

DOCUMENTARY RECORDS

Reviewed by Ellis Blain

NA ST. VINCENT MILLAY READING HER POETRY: Philips Caedmon TC 1123.

Edna St. Vincent Millay is perhaps the st individual of major American ts. As a result, the effect of her k on most readers — or listeners — argely subjective. If one is an admirer, n the more of her distinctive person- y that can be injected into a reading, more acceptable it is likely to be. This personal aspect can be expected over-ride mere technical prowess in st people's estimation, but it should be forgotten that Miss Millay's kly poetry readings were enjoyed by umerable radio listeners for many rs, and that she became in her life- e a rare combination of writer and der.

For this reason alone, this recorded moir is invaluable, and for one who ubject to her unique combination of nantic imagining with earthy sensu- y it is an ever exciting, ever new always private world of inspiration delight.

The actual recordings were made in RCA Victor Studios in 1941 and poems themselves were selected by author as the best of her work at t time.

* * *

HE TRIAL OF LADY CHATTERLEY" Pye Nonesuch Series PPLD 206-162.

The trial of "Lady Chatterley's Lover" te literally was the case of a book trial, although in listening to the dence it is often only too easy to gine that it is the characters in the k who are under discussion.

Nevertheless, this was a vitally im- tant case which, had it gone the other , would have been the precursor of ew dark age of literary suppression. , in Australia, are approaching a ilar climate to the one which existed Britain at the time of this trial. It oves us all, therefore, to inform our- es as thoroughly and as quickly as sible of the facts and circumstances that we may think for ourselves on vital matter concerning our own ntial liberties.

To remind us of the background, I uld quote the present British nister, Mr Roy Jenkins who, at the e of the trial was simply Roy Jenkins, P.

The Lady Chatterley Trial was able for a number of reasons, but not t because it was the first occasion British legal history on which a great ume of expert opinion was able to the Court its view from the witness about the literary merit of a book.

This was because it was the first pro- ution of an important book under the Obscene Publications Act which in- luced the innovation of a defence of ary merit, and specifically provided the hearing of expert witnesses. The had become law in the summer of 9 after a struggle lasting nearly five s . . . the Government's legal advisers e vehemently opposed to the inclu- in the bill of the important provision about expert evidence. It was only possible to secure this by a last minute arrangement under which a clause requiring the consent of the Director of Public Prosecution to any proceedings was abandoned in exchange.

"The bill which eventually received the Royal Assent was a compromise measure which by no means completely satisfied the reformers. But it achieved enough to be well worth having.

"This impression has since been fortified by the result of the Lady Chatterley case. We do not know — we cannot in the nature of things know — whether the jury decided that the book was not obscene under Section 1 of the Act, and did not therefore concern themselves with the literary merit defence or whether they decided that it was obscene, but were none the less influenced by the volume of expert evidence that it was for the public good that it should be published.

> *"English is a marvellous language — because it isn't a language; it's an agglomeration. It's a treasure-house of twenty-five or thirty languages."*
>
> *HAN SUYIN,*
> *in a BBC interview.*

"I doubt if they kept the two questions completely distinct in their minds. Probably few of us could, and I suspect that the weight of opinion, literary, educational and ecclesiastical deployed by defence influenced the jury's view about obscenity as well as about literary merit.

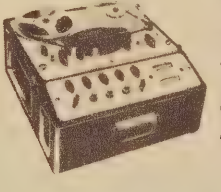
"In any event, I am sure that, particularly with an unfavourable judge, the much disputed provision about the calling of expert evidence was of the greatest possible importance."

I have devoted an unusual amount of space to this important set of two records, some ninety minutes of reconstruction and abridgment of what originally was a six day hearing. It remains only to say that the records tell an eminently listenable, often fascinating story which was edited from the official tarnscripts by C. H. Rolph.

The production by Jennifer Wayne makes use of a narrator to summarise tedious legal arguments and to avoid repetition of four letter words. The cast is outstanding with Maurice Denham as Mr Mervyn Griffith-Jones, Counsel for the Prosecution, Michael Hordern as Mr Gerald Gardiner, Q.C., Counsel for the Defence, John Le Mesurier as Mr Justice Byrne, and John Chandos as the Narrator. The minor parts are most convincingly portrayed and the introduction by Lord Birkett P.C. is as masterly as one would expect.

For sensitive ears it should be made clear that THE word occurs loud and clear at least once. The records are contained in an attractive album with adequate notes. They are available on indent order from retailers. ■

World famous **Brenell** Recorders, Decks, Tape Links



Model STB 2. Half track stereo or mono, record/playback plus quarter track playback, 4 heads, illuminated edgewise meters. 4 separate amps, twin recording amps with 4 inputs, each with individual attenuators, providing utmost flexibility with any combination of programme source. 4 channel mixing or mono. Twin playback amps with variable output via cathode follower. Adjustable bias compensation. Optional extras, stereo power amplifier with monitor speakers. Stereo recorder from $645, Mono from $352.

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Based on the R & H Playmaster 106 and 101 Amplifiers with these added features:—

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BALANCE
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- Loudness control giving bass boost at low volume.
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- Calibrated dial available for all states showing main stations in larger type.
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● Inbuilt high gain tuner with a frequency coverage of 530 to 1,600 K.C. ● EM84 tuning indicator giving accurate tuning with ease. ● Two channel tone control stage with separate bass and treble controls. ● Input facilities with switching for pick-up and stereo or mono tape recorder for record or play back. ● Chassis is plated and mounted in attractive and durable metal case finished in grey with control panel in black and silver with matching knobs. ● Valves used:—4 6GW8, 12AX7 or 12AU7, 6AN7, 6N8, EM84 and 2,210 diodes.

106 UNIT WITH TUNER

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- Incorporating Ferguson type O.P. 412 grain oriented output transformers giving a frequency response of 20 to 30,000 cycles.

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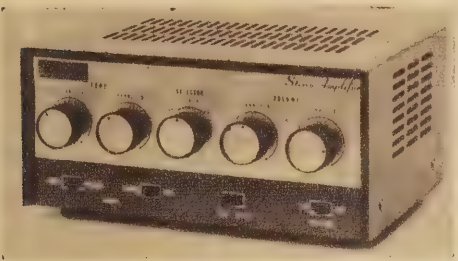

AMPLIFIER ONLY $39.00 (£19/10/).
POWER OUTPUT: 14 watts (7 watts per channel).
FREQUENCY RESPONSE: 40 to 15,000 cycles ± 1 db.
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EW "NYTONE" SOLID STATE HI-FI STEREO AMPLIFIER

SPECIFICATIONS

UTPUT POWER: 6 watts, 3W + 3W.
REQUENCY RESPONSE: 50 to 15,000 cycles.
UTPUT IMPEDANCE: 4 to 16 ohms.
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MODEL STR700 **$40**

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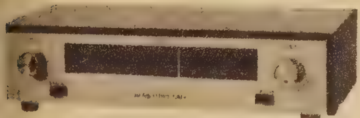

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Suitable for use with all valve or transistor Hi-Fi amplifiers, tape recorders or P.A. amplifiers.

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Frequency coverage 530 to 1600 K.C. Bandwidth 8·5 K.C. Inbuilt aerial, provision for external aerial. 240 volt A.C. operation. Dimensions 10¾in x 6in x 3¼in. Output variable from 150mv to 1.3 volt.

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Complete unit, built, wired and polished in walnut, teak or maple.

$30 (£15.0.0)

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Complete kit of parts less Cabinet but including Speakers, Inductance, Condenser, Resistor, Innabond and Speaker Silk.

$17.50 each Post and packing $1.25 extra.

Available 7½ or 15 ohm impedance.

Above units also available with 8WR Speaker in place of the 6WR at 30/ extra.

Dimensions 21in x 13¾in x 8½in.

THE NEW MULLARD BOOKSHELF MINI SPEAKER UNITS

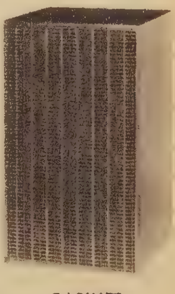
As featured in "Mullard Outlook," April, 1966, issue.

These units designed by Mullard and Magnavox engineers compare favourably with imported B/S Speakers costing more than twice the amount and are ideal where space is limited. Incorporates the Magnavox 6WR 6in Speaker and the new 3TC Mk 11 tweeter frequency response, 50 to 18,000 cycles. Power rating max. 8 watts. Polished in rosewood, teak, maple or walnut.

Available in 7½ or 15 ohm impedance.

$27 (£13/10/-) each

Post and packing: N.S.W. $1.50, Interstate $2.50



CABINET
DIMENSIONS
14in x 8in x 8in

CLASSIC RADIO

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BEOCORD 2000

LOOK! All these features in one uni

- ★ Professional standards for speed, wow and flutter.
- ★ True High Fidelity Stereo amplifier (solid state).
- ★ Three stereo inputs each with pre amplifier and slide potentiometer adjustment.
- ★ Separate record and playback amplifier and heads.

TECHNICAL DESCRIPTION:

Dimensions: Suitcase Model: 17.7in long, 14in deep, 10in high, including lid and speakers, 7.5in high less speakers. (Table model 8.2in high.)

Weight: 35lb. Table model 46lb. Suitcase model.

Supply Voltage: 240 volts 50 cycles AC.

Playing Time: Depends on speed and length of tape, e.g., 1800ft tape (7in reel with LP tape) ½-track version at 1 7/8" is 3 hrs. Fast forward and rewind: approx. 150 sec. in either direction for 1800ft tap (LP).

Power consumption: Motor: 27 watts. Amplifier (no signal) 8 watts or (full volume) 20 watts.

Reel diameter: 7in or less.

Heads:
Recording head: 10 /u gap: 2 x 15 mH.
Playback head: 3 /u gap: 2 x 30 mH
Ferrite erase head: 2 x 2 mH: 2 x 100/u.
The 2-track model has two erase heads.

Tape speeds:
7½in, 3¾in, and 1 7/8in/sec. Speed can be changed during operation.

Tape-length counter: Push-button for reset.

Automatic stop: At end of reel or if tape breaks. Operates on all tapes.

Pause stop: Lever can be locked.

Loop Compensator:
The take-up reel is equipped with a loop compensator to prevent jerks when starting. Provides smooth starting and stopping at any speed.

Main switch:
Integral with speed-change switch. Idler is disengaged when the switch is in the off position.

Amplifier Switch: The tape-recorder amplifier may be operated separately. A switch is provided for switching the amplifier on and off without startin gthe motor.

Recording-level indicator:
2 moving coil VU meters, have built-in pilot lights. White light for playback, red light for recording.

Mixer:
Three input channels with separate potentiometers for mixing the following: Microphone Input. The standard version is for balanced input for monaural or stereo quality microphone, such as the B and O Type BM5 or MD8 mono stereo microphone. Input sensitivity 150 /uV.

Gramophone Input: Input for low-impedance stereo pickups, such as B and O types SP1 and SP2. Input sensitivity: 2mV/1000 cs.
Compensated for RIAA curve.

Radio Input. Input sensitivity: 1) without pre amplifier. 45 mV/10 k ohms 2) with pre amplifier 5mV/45 k ohm. For connection to a conventional radio set. (All input sockets DIN.)

Monitoring Feature:
For listening in on tape programs both before and after recording. Monitoring of the recorder program is delayed by fraction of a second.

Output control:
Separate potentiometer for adjustment of playback volume and monitoring volume. Loudness compensated volume control.

Speaker switches: 3 push buttons 1, External speaker 2, built-in speaker 3. Built-in speaker attenuated (to permit microphone recording near the tape recorder).

Echo button:
While recording, the recorded signal can be mixed into the recording by depressing the echo button. This provides an echo corresponding to the time lag between the recording and playback heads. Separate control for Echo adjustment.

Multiplay.
For recording monaural, the echo button may be used for transferring a recording from one track to another. This feature permits one-man part-singing.

Synchronous Monitoring:
To secure synchronisation when recording pilot tones for an automatic slide projector, one half of the recording head may be monitored by depressing the synchronous monitoring button.

Line Input and Output:
Sockets in accordance with international standards. Line output voltage: 800 mV. Can be used for headphone monitoring

Connecting a Telephone pickup: The microphone input may be employed for connecting a telephone pickup.

Amplifier:
The amplifier is fully tranistorised. It comprises:

(1) a 2-channel microphone pre amplifier. 2 — AC 126: 2 — AC 107.

(2) a 2-channel gramophone pre amplifier. 2 — AC 107.

(3) a 2-channel radio pre amplifier: 2 —AC 126: 2 — AC 107.

The pre amplifiers are plug-in units. the outputs of three microphones are be mixed microphone pre amplifiers m be substituted for the gramophone amplifier and the radio pre amplifier.

(4) Recording amplifier. A separate channel recording amplifier is provid Transistors 4 — AC 126: 2AC1

(5) Playback amplifier. A separate channel playback pre amplifier is p vided. Transistors 6 — AC 126.

(6) Output amplifier. 2 8-watt transis power amplifiers are provided. Tra formerless output. Transistors 1 x 107, 1 x AC 128, 1 x AC 127, 1 x 132, 2 x AD 139.

(7) Power supply. Transistors 2 — 75, AC 128 AD 140. Diodes 15/517 2 x BY213.

(8) Erase oscillator. Transistors 2 x 128.

Controls operate only in the playb amplifier. Separate knobs for bass, tre balance.

Amplifier data and sensitivities. Out power 2 x 8 watts.
Harmonic Distortion: 1 per cent by watt output.

Frequency Response:
7½in½sec 30 — 20,000 c/s (±2 dB 4 16,000 c/s) 3¾in/sec. 30 — 16,000 (±2 dB 40 — 12,000 c/s), 1 7/8in/s 50 — 8,000 c/s (± dB 50 — 6, c/s).

Sensitivity:
Microphone input: 150 /uV. Gra phone input 2 m/V 1000 c/s. Ra input: 5mV. Line output: 45mV.
Line Output Voltage: 800 mV. Spea impedance: 3.5 ohms — 10 ohms. W values listed are for reproduct equalised according to normal listen weighting wow frequencies 4 c/s att uated 3 db/octave.

	Peak to Peak Value.	RMS Value
7½in/sec.	0.2%	0.07
3¾in/sec.	0.3%	0.1
1 7/8in/sec.	0.5%	0.1

Channel separation: better than 45

Signal/Noise Ratio:
½-track: 55 db at a recording level ducing 3 per cent harmonic distort
¼-track: better than 50 db at a rec ing level producing 3 per cent harm distortion.
Technical data is subject to cha without notice.

Before you buy a tape recorder or amplifier, listen to a BEOCORD at:

DANISH HI-FI PTY. LTD. 66 Mayston Street, Hawthorn, Victor

N.B. Close to Camberwell Railway Station in the "Hub" Building

VARIETY FARE

★ "ELECTRONICS Australia"

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Devotional

HE CRUSADER MEN. Directed by ; Don Hustad. Tedd Smith, piano; Gil Mead, organ. Produced by Cliff Barrows, Stereo, Word (Gospel Film Ministry) WST-8334-LP.

Interest: Male voice choir.
Performance: Polished.
Quality: Good.
Stereo: Normal spread.

Organised in relatively recent times, e Crusader Men is a male voice choir, ntred in Chicago and formed from stors, church musicians, professional ngers and businessmen. Its main activ- / is to provide choral music for the lly Graham "Hour Of Decision" radio ogram, alternating with Crusade oirs.

Being directed, produced and accom- nied by regular members of the Billy raham musical team, it is not surpris- g to find it a very well trained and ghtly disciplined group.

It would take a feat of memory to mpare them with other male choirs oout which similar remarks have been ade. Sufficient to say that they are ood—very good—and are well worth a earing if the hymn titles appeal: On- ard Christian Soldiers—There Is Glory My Soul—The Sweetest Name—'ounded For Me—Praise Ye The Lord -'Twas Jesus, Blood — Saviour My eart Is Thine — The Church In The 'ildwood—O For A Thousand Tongues -He The Pearly Gates Will Open—ejoice, The Lord Is King—Saviour, I 'ill Follow Thee — Wonderful Peace ledley.

In terms of quality, the recording is ell up to standard. A record that will ertainly appeal to all who like tradit- nal four-part male voice harmony. V,N.W.)

* * *

HE THREE SONS GOSPEL TEAM. Mono, Sacred SLP-223. (Supreme Productions S.E. Asia Ltd., Box 15, Footscray W11, Victoria).

Interest: Popular Gospel songs.
Performance: Platform style.
Quality: Average.

A feature of modern church life, at ast in evangelical circles, is the number instrumental and vocal groups which 'culate in major centres, featuring in uth rallies and Gospel services. In this ntext many of the groups have an im- ortant ministry of entertainment and stimony. Very few, however, have the lish and kind of musical sophistication meet the exacting demands of ound-only" presentation on modern cordings.

To my ear, this program by the Can- ian Three Sons Gospel team sits right the border-line. It is the kind of estern style" presentation that goes wn very well on Gospel rally plat- ms—hence my use of the term to alify "performance." The songs, too are established favourites and will find their own audience: Mansion Over The Hilltop—At The Foot Of The Old Rugged Cross—We'll Talk It Over—If I Could Live Over—It's Not An Easy Road—At Eventide—Make My Life To Be—How Long Has It Been—Cleanse Me—Over The Sunset Mountains—Down Deep In My Heart—Beside The Still Waters—Take A Little Time To Sing.

A generous and popular program indeed but those who listen more critically will hear rough edges and a routine sameness that may mar their enjoyment of the music. The quality, I'd rate in much the same fashion—adequate for casual listening but certainly not up to the phrase on the label: "Ultra-Fidelity Recording."

In short, pleasant enough for casual listening and sing-a-long but not for critical listening. (W.N.W.)

* * *

J. S. BACH: Easter Oratorio, BWV 249 Soloists with the Heinrich Schutz Choir of Heilbronn and Pforzheim Chamber Orchestra conducted by Fritz Werner, World Record Club 12-inch stereo, ST 4062.

Interest: Sacred music.
Performance: Dignified, restrained.
Recording: Excellent.
Stereo Quality: Smooth.

For those who are lovers of the sacred oratorio and Bach's Easter Oratorio in particular comes this recording made originally for the French Erato label. It features soprano Edith Selig, contralto Claudia Hellmann, tenor Georg Jelden and bass Jakob Stampfli, with Georg Terebesi, violin; Hartmut Strebel, flute; Pierre Pierlot, oboe; Maurice Andre, trumpet; Jacoba Muckel, cello; and Eva Holderlin organ and harpsichord. Accompaniment is by the Heinrich Schutz Choir of Heilbronn and the Pforzheim Chamber Orchestra conducted by Fritz Werner.

The Easter Oratorio is perhaps less memorable than Bach's Christmas Oratorio; there is no Evangelist narrator, there is not a single quotation from the Gospels, and there are no chorales. The actual story remains in the background, taken for granted; one is simply presented with the reactions of a group of worshippers on having learnt of the risen Christ. Although some of the music is quite joyful and some quite moving, the overall result seems rather cold and restrained.

The performance in the present recording is of a high standard, with highly competent soloists and solid backing. However, to my mind, it is a little too dignified; it lacks sufficient warmth to bring the already restrained music into glowing life. Nevertheless at times it makes moving listening.

The recording itself is of a very high quality, with extremely low tape noise and distortion. The stereo spread is smooth and wide.

For those who would like a somewhat dignified recording of the Easter Oratorio, this would be a good choice. (J.R.)

* * *

THE GREATEST STORY EVER TOLD. Original motion picture score by Alfred Newman. Produced by George Stevens. Stereo, United Artists UALS 8013.

Interest: The film and its music.
Performance: Deliberately restrained.
Quality: Normal.
Stereo: Normal.

Like most recordings of motion film music, this album poses a problem to the reviewer. Not only is it difficult to divorce it from its cause d'etre but there is the basic question of whether one should even attempt to do so. By its very nature, film music must complement the visual, not compete, and solus presentation is not a prime consideration in its composition.

For those who have seen the film, it will certainly cause them to re-live the experience, and this may be sufficient reason to want to have the album in their library.

For those who have not—and I am one of them—it is possible only to let

"INNERBOND" (Regd.)

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For packing in

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A new resilient Bonded Wadding made from ultra fine Cellulose Acetate Fibres that gives high efficiency for Sound Absorption.

"INNERBOND" is light, clean dust free and easy to handle. Because all the fibres are bonded "INNERBOND" will hang as a "curtain" and will not fracture or break down due to vibration.

"INNERBOND" is odourless, highly resistant to attack by bacteria or fungus and is vermin repellent: "INNERBOND" at 16oz sq. yd. has a nominal thickness of 1" and at this density is recommended as a packing in Speaker Enclosures for Sound Absorption.

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MELBOURNE—J. H. Magrath and Co. Pty. Ltd., 208 Little Lonsdale St.
BRISBANE—A. E. Harrold Pty. Ltd., 123 Charlotte St.
ADELAIDE—Duncan Agencies, 57 Woodville Rd., Woodville; General Accessories, 81 Flinders St.
PERTH—General Accessories, 46 Milligan St.

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For 4 sq. yds. as above send $6.50

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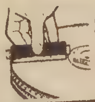
The original "DUST BUG" (Regd.)

Automatic Record Cleaner. Easily fitted to any transcription type turntable — the "Dust Bug" provides a simple and effective method of removing static and dust while the record is being played. Surface noise and record and stylus wear is reduced resulting in cleaner reproduction.

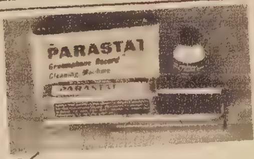
The "PARASTATIK" DISC PREENER (Regd.)

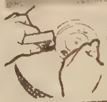


Place 'Preener' on to recorded area and press lightly and evenly while the record slowly rotates.

Expressly designed for use with new records and is able to collect all dust from the record surface without the use of anti-static agents. The plush pile penetrates each groove giving ideal playing conditions for ultra-light stylus pressures. Reduces background noise ensuring greater listening pleasure.

The "PARASTAT" Manual Model Mk. IIa.





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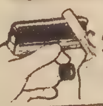

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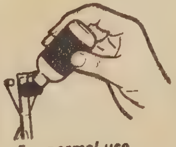

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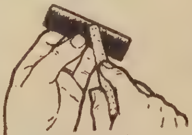

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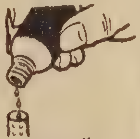

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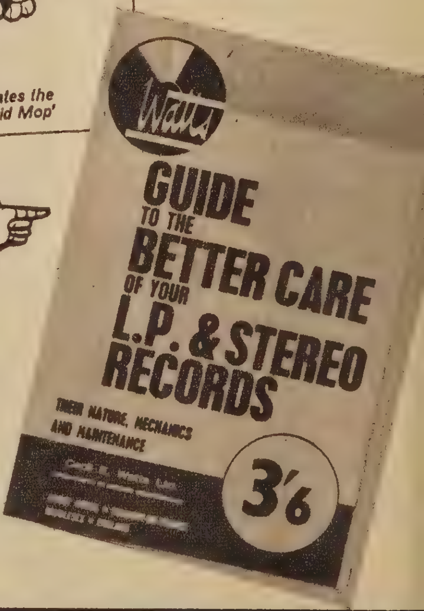
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music speak of the scenes which it
npts to portray and these are certain-
amiliar:
sus Of Nazareth (theme) —A Pro-
y —A Voice In The Wilderness —
e Unto Me — The Great Journey
Time Of Wonders —There Shall
e A Time To Enter —A New
mandment — The Hour Has Come
Into Thy Hands — The Triumph
The Spirit (Handel's Messiah).

these themes the music is certainly
opriate — tranquillity, loneliness,
w, triumph — but music needs
e more than appropriate to win
ptance in its own right. Time alone
establish this.

the meantime, I somehow feel that
album is mainly for those who
seen the film and become emo-
ally involved in its portrayal of "The
test story ever told." (W.N.W.)

* * *

HAND IN MINE. Elvis Presley with The Jordanaires. Stereo. RCA SLP-2328. Also available in mono LPM-2328.

Interest: Elvis, I guess.
Performance: Intense, smooth.
Quality: Flawless.
Stereo: Normal spread.

CA have apparently re-released this
m which I remember reviewing quite some time ago. Doubtless they hope to entice a new and different cycle of Elvis fans.

In terms of performance I have to give it absolutely top marks, with the honours shared equally by the soloist and by that excellent back-up group, the Jordanaires. There's not an untidy note or beat from start to finish.

How individuals will react to the disc, however, will depend mainly on their reaction to Elvis Presley. As for teenagers I have few doubts; he's their kind of singer, it's their kind of music, their kind of "with it" Gospel —an observation which is not intended as ridicule.

But adults may react differently, unconvinced by the "choir boy" portrait on the front cover and the build-up to match on the back.

The titles: His Hand In Mine — I'm Gonna Walk Dem Golden Stairs — In My Father's House — Milky White Way — Known Only To Him —I Believe In The Man In The Sky — Joshua Fit The Battle — Jesus Knows What I Need — Swing Low Sweet Chariot — Mansion Over The Hilltop —If We Never Meet Again —Working On A Building.

One you should hear for yourself and don't blame me if it starts an argument between generations! (W.N.W.)

nstrumental, Vocal & Humour

'ALDI: Concerti for Diverse instruments. Concerto in C major for 2 trumpets, strings and cont., P. 75; concerto in A minor for piccolo, strings and cont., P. 83; concert in B-flat major for violin, oboe, strings and cont., P. 406; concerto in G major for 2 violins, 2 cellos, strings and cont., P. 135; concerto in F major for violin, organ strings and cont., P. 274. The Jean-Francois Paillard Chamber Orchestra conducted by Jean-Francois Paillard. World Record Club 12-inch stereo, ST-4066.

Interest: 18th-century chamber gems.
Performance: A trifle stiff, but lively.
Recording: Excellent.
Stereo Quality: Smooth, wide.

urely there are few classical music
rs who do not enjoy listening to at
t some of the music of Antonio
ldi, born c. 1678, died 1741. Perhaps
is true partly because of his
omenally large and varied output;
in great measure it is a function of
tremendous charm and appeal of
ost all of his music. Buoyant, happy,
rnately light and carefree and mock-
bre, it is almost vibrant in its affir-
ion of 18th-century confidence; un-
ming and undemanding of the lis-
r, it seems as fresh today as when
as written. Little wonder that Vivaldi
ired a whole era of musical composi-
and was much admired by such
ts as Bach, Handel and Telemann.

mong the most enjoyable of Vivaldi's
ks are the great number of instru-
tal concerti, five of which are pre-
ed on this disc. With bright and
hmic melodies, and wonderful bal-
between the assorted solo instru-
ts and the orchestra, they make very
xed and entertaining listening.

he recording on this disc is from the
emed Erato label and features the
Jean-Francois Paillard Chamber Orchestra and soloists as follows: in P. 75, Maurice Andre and Marcel Lagorce (trumpets); in P. 83, Maxence Larrieu (piccolo); in P. 406, Pierre Pierlot (oboe) and Haguette Fernandez (violin); in P. 135, Haguette Fernandez, Ginette Carles (violins), Bernard Fonteny, Constance Maurelet (cellos); in P. 274, Huguette Fernandez (violin) and Marie-Claire Alain (organ). Harpsichord continuo is by Anee-Marie Beckensteiner. The recording was made in the German Evangelical Church, Paris.

The playing is of a high standard throughout; perhaps a little stiff and formal, but quite lively. The harpsichord continuo is not much in evidence, but the soloists were well balanced and play extremely well. On the whole I think the most impressive performances are given by the soloists in the C major trumpet work, although Marie-Claire Alain gives some fine playing and upper manual playing in the F major organ concerto.

The recording is of excellent technical quality, with very low noise and negligible distortion. The stereo is smooth and widely spread without exaggeration.

A fine recording of works which deserve a place in any classical record collection, and warmly recommended. (J.R.).

* * *

ROSE MARIE—THREE LITTLE WORDS. Selections from the soundtracks of the M.G.M. films. With Howard Keel, Ann Blyth, Fernando Lamas, Fred Astaire, Red Skelton. M.G.M. Studio Orchestra conducted by George Stoll, Previn M.G.M. "Encore Series" 12-inch mono, MGM-VO2-9180.

Interest: Show-film music.
Performance: Authentic.
Recording: Fine.

A re-release of highlights from the soundtrack recordings of Rose Marie

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Than Springtime • I Got Rhythm • Till There Was Y
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Fox Trots, and four ever-popular Waltzes.

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"Never On Sunday," "The Apartment," "The Magnific
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Things • Autumn Leaves and 8 more.

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of 12 beautiful melodies.

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cluding: The Breeze And I • Blue Moon • That
Black Magic and nine others.

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pieces—each of them a favourite with lovers everywhe

l Three Little Words, on M.G.M.'s nomy Encore Series label. For those o missed the original recordings, it sents an ideal opportunity to obtain highlights at a bargain price.

The tracks are titled: The Right Place A Girl — Free To Be Free — Love l Kisses—Indian Love Call— Rose rie—I'm A Mountie Who Never Git Man—I Have The Love—Mounties, l (side 2) Nevertheless—I Love You Much—All Alone Monday—Where l You Get That Girl?—Thinking Of u—I Wanna Be Loved By You— o's Sorry Now?—Medley: My Sunny nessee—So Long! Oo-Long—Three tle Words.

The recording is a little restricted in ge both tonally and dynamically, but therwise fine. (J.R.)

* * *

SMET: The original cast album, with Alfred Drake, Anne Jeffreys, and Lee Venora. Music based on themes by Alexander Borodin. Produced for records by George R. Marek. RCA Dynagroove 12-inch stereo, LSO-1112. Also in mono on LOC-1112.

Interest; Show music.
Performance: The original cast.
Recording: Excellent.
Stereo Quality: Wide and smooth.

The original cast recording of the sic Theatre of Lincoln Centre, New rk, performance of the Wright-Forrest sical "Kismet," directed by Edward eenberg. It makes exciting and enjoy- e listening, all the more so because the musical derivation from the works Borodin. Soloists Alfred Drake, Anne fries and Lee Venora give very bright l sparkling performances.

The tracks are titled: Overture—Sands Time—Rhymes Have I—Fate—Not ce Ninevah—Baubles, Bangles and ads—Stranger in Paradise—He's In ve—Gesticulate—Bored—Night of My ghts—Was I Wazir?—Rahadlakum— d This Is My Beloved—The Olive ee—Zubbediya—Finale.

For show music lovers, recommended. e recording is of excellent quality. R.)

* * *

ROUSEL, Richard Rodgers and Oscar Hammerstein II. Original cast album from the Music Theatre of Lincon Centre. With John Raitt, Eileen Christy, Susan Watson, Katherine Hilgenberg, Reid Shelton, Jerry Orbach, Benay Venuta and Edward Everett Horton. Stereo, RCA LSO 1114. Also available. in mono LOC-1114.

Interest: Popular musical.
Performance: Topline.
Quality: Flawless.
Stereo: Separation emphasised.

Adapted from "Liliom" by Hungarian ywright Ferenc Molnar, Carousel is on the seashore at Maine, U.S.A. ere a factory girl, on her day off, ls in love with a swaggering, hand- ne carnival barker, Billy Bigelow. eir anything-but-placid marriage is cut ort when Billy is accidentally killed, ile trying to steal money to meet enses for the child which his wife o bear him.

Seventeen years later, Billy is given opportunity to make amends for his k of responsibility when he is allowed leave Heaven for long enough to help former wife and now-teenage ughter. They all live happily ever after, resume!

On the album you hear: Prologue — A Queer One, Julie Gordon — If I Loved You — June Is Bustin' Out All Over — Mister Snow —Blow High, Blow Low — When The Children Are Asleep — Soliloquy — A Real Nice Clambake — What's The Use of Wondrin' — You'll Never Walk Alone — The Highest Judge Of All — Finale Ultimo.

The whole presentation is first class, with excellent diction, excellent quality and clever use of stereo facility, A good one. (W.N.W.)

* * *

FESTIVAL - AMERICA STEREO SAMPLER. Festival, Stereo SDL-2/4.

Interest: Various American artists.
Performances: Some of the best.
Quality: Very good throughout.
Stereo. Normal spread.

This disc features a selection of items by some of America's top recording stars extracted from best selling discs from the American Decca and Coral catalogues. Since it is intended to act as an appetiser for the full-length LP discs of the artists concerned, it represents some of the best performances from their current recordings.

Not surprisingly it makes very enjoyable and entertaining listening, and interest is sustained throughout by the variety between tracks. And the price is enjoyable too — $2.95 to be precise.

Beyond this, and a mention of the fact that the sound quality and stereo separation are both very good, it seems necessary only to list the tracks. Here they are: Cafe Oriental (Lenny Dee) — Gotta Travel On (Pete Fountain) — Charade (Wayne King) — Where Have All The Flowers Gone? (Grady Martin) — Chim Chim Cher-ee (Xavier Cugat) — Dear Heart (Carmen Cavallaro) — Song of India (Big "Tiny" Little) — The Girl From Ipanema (Warren Covington) — Don't Get Around Much Any More (Robert Maxwell) — I Left My Heart In San Francisco (Earl Grant) — Washington Square (Sammy Kaye) — El Gato Montes — (Rafael Mendez). (H.A.T.)

* * *

THE VIRTUOSO PIANO QUARTET. Reader's Digest R.C.A. Dynagroove, Stereo CSC-311. Available from Reader's Digest Association, Pty. Ltd., 86 Stanley Street, East Sydney.

Interest: Classics arranged for piano quartet.
Performance: Skilful.
Quality: Excellent.
Stereo: Normal spread.

This disc features the unusual combination of four pianos playing as a quartet. Four pianos playing in ensemble might sound like a lot of noise, but the playing of the Virtuoso Piano Quartet is remarkably restrained and disciplined, so that at times it is difficult to realise that there is more than one performer.

The four performers have very impressive backgrounds in the world of classical music, details of which cannot be given here for space reasons. The arrangements are by the performers themselves and it is noticeable that they are essentially pianistic in character, whereas most arrangers try to make the piano imitate the sounds of a full orchestra.

Opinions will no doubt differ about the success or otherwise of these arrangements, but for my part I enjoyed every

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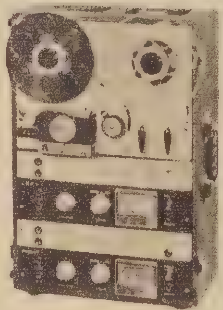

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note of the Lecuona "Malaguena"
the "Jota" (Spanish Dance) from
de Falla Opera "La Vida Breva" w
I was not so keen on what the sl
note calls "piquant modern harmon
in some of the other pieces. To
more conservative ears, these sound
markably like discords.

Barring this small quibble, I can
commend this disc to those who
pleasure in piano arrangements, esp
ally as it can be bought at the spe
Reader's Digest price of $1.

The full list of titles is: Malagu
(Lecuona) — Flight of the Bumble
(Rimsky Korsakoff) — The Swan (S
Saens) — Artist's Life Waltz (J. Str
Jnr.) — Yankee Doodle Dandy (T
arranged Kaye) — Spinning Song (M
delssohn)—Liebesfreud (Kreisler)—
from La Vida Breva (de Falla). (H.A

* * *

**COMMAND STEREO SPECTA
LAR. Produced by Enoch L
Stereo, Universal Record C
SUP-770.**

Interest: Hi-fi spectacular.
Performance: Virtuosi.
Quality: Very clean.
Stereo: Separation emphasised.

Enoch Light, the moving force beh
Command records, is ever the expon
of the novel and spectacular and, w
he sets out to make a spectacular,
end result is never in doubt. The arran
ments are lively and each channel s
plies its own distinct quota in a pres
tation that should delight those who
listening to that—and that!

A bevy of well-known Comm
artists contribute to the program, incl
ing Enoch Light and his orchestra,
Dick Hyman Trio, the Ray Cha
Singers, Tony Mottola, Doc Severin
and Don Lamond.

The track titles: I Want To Be Ha
— Cry Of The Wild Goose — Misty
Happy Days Are Here Again—Besa
Mucho — In A Little Spanish Town
Cheek To Cheek — Guitar Espanol
Love For Sale — Moon River — Vi
Vieni — Forty Second Street.

Good, if you like hi-fi of the spirit
popular variety. (W.N.W.)

* * *

**SEMPRINI IN CONCERT. Semp
with orchestra conducted by Vi
Tausky. E.M.I. Mono OCLP 3
(Also available in Stereo OC
3512.)**

Interest: Light classical piano.
Performance: Competent.
Quality: Very Good.

Semprini is not in the same class
say, Rubinstein or Horowitz, nor has
ever pretended to be. However, he pl
the type of light classical piece presen
on this disc very well. Purists may fro
about some of the arrangements of pi
pieces for piano and orchestra, but
disc is not intended for purists, as
sleeve note makes plain.

Apparently Semprini regards it as
metier to bring the classics to th
who do not normally listen to this t
of music. His technique is apparent
the order of pieces on this disc. F
come some of the better known ea
appreciated melodies; these are follow
by lesser known or more "difficu
works, although even these do not m
any great demands on the listener. Th
later works, by the way, may make
disc worthwhile for more seasoned l
eners, since some of them are seld

ded in concert or recorded pro- s.

e titles: Perpetuum Mobile (trad. ged Weber)—Warum (Schumann— omptu Op. 90, No. 4 (Schubert)— z in A Flat Op. 34 (Chopin)—The Wedding (Mendelssohn)—Hungar- Rhapsody No. 13 (Liszt)—Arkansas eler (Guion)—Melodie Op. 3 No. Rachmaninov)—Cry of the Birds eau)—Lento from Grand Fantasie, 13 (Chopin)—Scherzo, Lyric Suite 54 (Grieg) — Tarantella Vivace d.) — Triana, from Iberia Suite eniz). (H.A.T.)

* * *

HT ORCHESTRAL FAVOURITES. The Vienna Promenade Orchestra, conductor Hans Hagen. Festival, Stereo SFL-931,843. Also available in Mono FL-31,843.

Interest: Popular light classics.
Performance: Pleasing.
Quality: Good.
Stereo: Normal spread.

e Swiss Elite company, which ori- ly recorded this disc, seem to be ng something of a specialty of light ics. Festival have released at least iscs of this type in about as many s, and I must say I greatly prefer ater releases to the earlier ones. The ' acoustic of the sound quality ed by all our reviewers in earlier ses is not so much in evidence in disc, while the Vienna Promenade estra seems to be a cut above some e others recorded by Elite.

one of the tunes presented here d qualify for the title of "master- " but it is a very pleasant collection obvious appeal to those who like classics: Petersburgh Sleighride— ade (Toselli)—Japanese Lantern e—Souvenir—The Glow Worm— Guard Parade of Gnomes—Parade he Wooden Soldiers—Poeme and —Serenade (Drigo)—The Skaters' z—Moonlight on the Alster—Sere- (Heykens).

e sound quality is good without good enough to qualify for an ellent" label, while the stereo spread ite effective. (H.A.T.)

* * *

'S OFF. The Mariachi Brass featuring Chet Baker. Festival, Stereo SFL-931,984. Also available in Mono FL-31,984.

Interest: Jazz trumpet with Mariachi and brass.
Performance: Competent.
Quality: Excellent
Stereo: Normal spread.

ass plus Mariachi and percussion ds like a familiar formula and Baker lays himself open to charges lagiarism in an attempt to cash in the present popularity of the na Brass. At first hearing one gets impression that the group is pting a frank imitation of Herb rt's group, but . . . wait a minute Chet Baker is playing JAZZ . . . thing that Herb Alpert has left ely alone to date.

ere he is weaving coolly in, out around the melody with improvisa- , while the rest of the group play ht in the Tijuana Brass style. Is an improvement on the magic ula which sent the Herb Alpert to the top of the hit parade? kly, I feel that Herb Alpert need ose any sleep over the competition, jazz devotees might prefer the Mariachi Brass sound to the Tijuana Brass approach. In any case, those who like the Herb Alpert group are also likely to find pleasure in this disc, which is a very close approach to the playing of the better known group. Sound quality and stereo are equal to the best modern standards.

VICTOR HERBERT ON STAGE. The Roger Wagner Chorale, with orchestra conducted by Roger Wagner. Stereo. World Record Club ST-4002.

Interest: Timeless melodies.
Performance: First rate.
Quality: Excellent.
Stereo: Beautifully spread.

From the opening chords I knew I was going to like this record and, if this seems an abrupt and rather rash judgment, I can only say that listening to the whole disc merely verified it.

The orchestral tone is rich and generous, the choral work beautifully displayed by the stereo and the solo work equally enjoyable. Add to this the rich harmonies of Victor Herbert and you have a record which it would be almost impossible not to enjoy: In Old New York — Ah, Sweet Mystery Of Life — Every Day Is Ladies' Day—A Kiss In The Dark— Toyland—Tramp, Tramp, Tramp — Indian Summer — Slumber On, My Little Gypsy Sweetheart—When You're Away—Thine Alone—Moonbeams.

Need I say any more? It's a beauty! (W.N.W.)

The titles: Happiness Is — Sure Gonna Miss Her — Bang, Bang (My Baby Shot Me Down) — Senza Fine (The Phoenix Love Theme) —These Boots Are Made For Walking — On the Street Where You Live —Armen's Theme — Spanish Harlem — Chiquita Banana — When the Day is All Done (Foyo) — You Baby — It's Too Late. (H.A.T.)

* * *

FEVER! Doc Severinsen, his trumpet and orchestra. Command 12-inch stereo, SNDL-931,909.

Interest: Pop trumpet.
Performance: Lively.
Recording: Fine.
Stereo Quality: Widespread.

A lively and easy-to-listen-to disc of mixed tunes played by trumpeter "Doc" Severinsen, with Tony Mottola, Dick Hyman, Bob Haggart, Bob Alexander and many others of the Command gang giving support. The tunes come from folk, jazz, gospel, theatre, country and pops; the arrangements are imaginative and bubbly and were written by Dick Hyman.

The tracks are titled: In A Little Spanish Town — On A Clear Day (You Can See Forever) — Cotton Fields — Walk Right In — The Sidewinder — Raggedy Jim — The Lady In Red — Tennessee Waltz — Fever — Ja-Da — He's Got The Whole World In His Hands — Cleopatra's Asp.

The recording is of a high quality, as one would expect from Command. The stereo is smoothly and widely spread.

Highly recommended to trumpet lovers and also for dancing. (J.R.)

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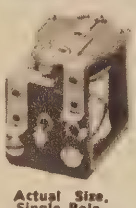

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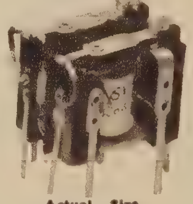

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Sydney.
Interest: Popular pianist plays
lar songs.
Performance: Smooth, suave.
Quality: Excellent.
Stereo: Normal spread.

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from Reader's Digest Association
you can buy for the low price o
On this record you get 10 medley
famous tunes played by that spe
of the "cocktail piano" style, Fr
Carle.

In all, 30 songs are included i
10 medleys, representing some o
best known (and most often pl
tunes of our time. These are giv
deft and polished performanc
Frankie in straightforward. arranger
admirably suited to the "cocktail lou
atmosphere.

The 10 tracks are entitled: V
Young Medley — Johny Green M
— Hoagy Carmichael Medley — V
Medley from the Operettas — Ra
and Robin Medley — Coslow and
ston Medley — Whiting and F

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AIWA DM.14 DYNAMIC MICROPHONE—Impedance: 50Ω or 50K. Frequency Response: 90 c's-14,000 cps. Sensitivity: 75 db's. Dimensions: 3⅜" x 1¾". Wt. 10 ozs. **$12.50**

DM57

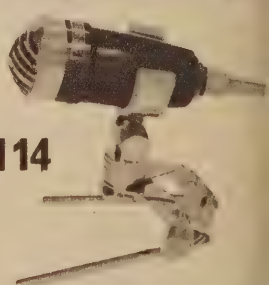
DM17

DM51

DM13

DM1

DM47



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ley — Rodgers and Hart Medley —
Cha Medley — Academy Award
ley.
e tune titles are too numerous to
in full, but here is a representative
tion. Golden Earrings — Blue
ids — The Nearness Of You —
bond King Waltz — Just One More
ce — Louise — Beyond The Blue
zon — Isn't It Romantic — Pent-
e Serenade — Mimi — Buttons and
s — Moon River.
espite the low price tag, the tech-
quality is up to the usual high
agroove standard. Definitely not to
nissed at the price. (H.A.T.)

★ ★ ★

**NTEMPORARY GUITAR MUSIC.
JOSE LUIS GONZALEZ. SBR
SBR 235157.**

Interest: Classical Guitar music.
Performance: Exquisite.
Quality: Excellent.
Stereo: Not significant.

enor Gonzalez is now in the top
of guitarists, and his performances
additionally a degree of refinement
restraint which surpasses that of
e better known performers on the
ument. On this disc he plays a selec-
of pieces by twentieth century com-
rs with exquisite skill and feeling.
irtuosity for its own sake is not a
ure of the guitar playing of the classi-
school, consequently there are no
es of showiness in these pieces. Des-
this absence of "fireworks," those
some knowledge of the guitar will
eciate the immensely difficult nature
ome of the pieces and the superb
nique of Senor Gonzalez which
es them seem deceptively simple.
lthough all the pieces have the as-
gent quality of Twentieth Century
ic, they are not at all difficult to
n to. The sound quality is very good,
the stereo has no noticeable effect
seems rather an unnecessary pro-
n in this type of recording.
he titles are: Six Preludes (M.
ce) — Theme Varie et Finale (M.
ce) — Tonadilla for guitar on the
e of Andre Segovia (Castelnuovo-
esca) — Musical Pictures for Guitar,
2 and 3 (S. Libaek) — Six Preludes
Tarrega) — Mazurca (A. Tasman)
Choros (H. Villa-Lobos)—Medallon
guo (A. Barrios).
his is likely to be the last Australian
rding by Senor Gonzalez for C.B.S.,
e is leaving our shores for the (pre-
ably) greener pastures of Europe and
A. (H.A.T.)

★ ★ ★

**CI PLAYS SARASATE. Ruggiero
Ricci (violin) accompanied by
Brooks Smith (piano). Festival-
Decca, Mono only, DL-32003.**

Interest: Spanish composer.
Performance: Dedicated.
Quality: Excellent.

rasate was more a virtuoso per-
er than a composer, and never
ed a large scale work, such as a
erto, but his compositions, while
numerous, are worthy of more
tion than they have received to
The eight Spanish Dances which
the major part of this recital are
g the best of his works.
sentially melodic in character, they
in places breathtakingly beautiful.
ugh the first (Malaguena) and
(Zapateado) are often used by
ists in recitals, this is the first
ding of the complete set, according
e sleeve note. The other three
s are full of graceful tunes and make fitting companion pieces to the set of Dances in a Sarasate recital.

Ricci is Italian by birth, but shows he has a natural affinity to Sarasate's Spanish idiom. His playing is always suited to the mood of the piece, being at times cooly detached, at others ardently committed, and while at times his technique seems stretched to the limit in difficult passages, his fine tone and expressive phrasing should satisfy the most discriminating critic.

Brooks Smith — the American Gerald Moore — accompanies sympathetically and unobtrusively. Indeed, I thought he was a little too restrained in parts, but this could be because he seems to be placed rather too far from the microphone. Still the emphasis should be on the violin and altogether, this is a fine disc for those who like the Spanish idiom in music.

The eight Spanish Dancers are entitled Malaguena — Habanera — Romanza Andaluza — Jota Navarra — Playera — Zapateado — Spanish Dance No. 7 — Spanish Dance No. 8. The remaining pieces are: Introduction and Tarentalla — Caprice Basque —Serenade Andalouse. (H.A.T.)

★ ★ ★

DISTANT DRUMS. Jim Reeves. RCA. Stereo LSP-3542. Also available in Mono LPM-3542.

Interest: Modern ballads.
Performance: Rather "dry."
Quality: Good.
Stereo: Artificial variety.

Before he was killed in a plane crash in 1964, Jim Reeves enjoyed considerable popularity as a recording artist, and made many discs for RCA. He described himself as a singer of ballads, but his songs were rather the folksy and whimsical type, rather than the quasi operatic variety usually associated with ballad singers.

The disc takes its title from the first song sung by Jim Reeves in this selection. It appears that it has not previously been issued as a recording, and RCA may well have discovered hidden treasure, since this number has all the ingredients that took "The Ballad of the Green Beret" to the top of the sales charts—a tune in march tempo embellished by drum beats and bugle calls with lyrics which have application to the Vietnam conflict (although somewhat obliquely in this case).

The remaining titles are typical of the Jim Reeves style—ballad type tunes, each one very much like all the others, the lyrics heavy with sentiment. However, there can be no doubt that there is a considerable market for this type of disc and, for those who like the Jim Reeves style, this is as good as any other I have heard, and the sound quality is extremely good too.

Distant Drums—Is It Really Over—I Missed Me—Snow Flake—A Letter to My Heart—Losing Your Love—This is It—Not Until the Next Time—Good Morning Self—Where Does a Broken Heart Go—Overnight—The Gods Were Angry With Me. (H.A.T.)

★ ★ ★

BALLAD TIME — WITH TAUBER. Richard Tauber with orchestral accompaniment conducted by Henry Geehl. Mono, Parlophone PMAO-7009.

Interest: Once famous tenor.
Performance: High standard.
Quality: Quite acceptable.

Here is another recording from an era when soloists had to rely heavily on

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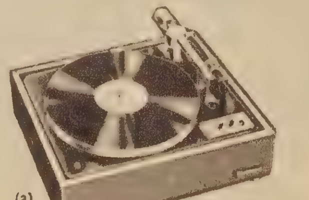
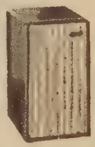


(a)

(b)

(c)



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THE WORLD'S MOST FAMOUS PERFORMER'S MICROPHONE

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vocal talent, without all the gim-
s and the props that are so common
days. And whatever one might have
;h of Tauber's mannerisms and
t, the fact remains that his reputa-
was built solidly on ability and
cianship.

this album, Parlophone have as-
led a dozen of the popular (not
') songs which Tauber sang with
wide appeal: Passing By — Bless
House — Parted — The Rosary
Lovely Night — Macushla — Ave
a (Schubert) — Tis The Day —
ttle Love, A Little Kiss — Angels
d Thee — Down In The Forest
aire My Girl.

rlophone engineers have done an
lent job in transcribing the record-
to microgroove. The frequency res-
is limited, as one might expect
ou will hear very little noise or
rtion, provided owners of wide-range
ns take the precaution of turning
eble down to match the sound on
isc.

short, if you have nostalgic memo-
of Tauber as a ballad singer, or
l like an album in your collection
istorical reasons, this one is well
considering. The jacket carries a
ait on the front and biographical
on the back. (W.N.W.)

* * *

**NG AND FOOLISH. Popular
ongs by Eddie Fisher arranged and
conducted by Ernie Freeman. Uni-
versal Record Club stereo SUP763.
Also available in mono, UP763.**

Interest: Popular songs.
Performance: Fair.
Quality: Good.
Stereo: Segregated.

is could be one instance where a
record could prove to be more
able than the stereo version, The
r and orchestra are so divorced in
tereo version that one gets the feel-
hat both were recorded on separate
ions and then put together.

ile Eddie Fisher has quite a pleas-
voice, a lack of affinity with the
npaniment is apparent on several of
racks. However, some good rhythm
e accompanists should appeal to the
ger set and, as such, enhances the
of the record.

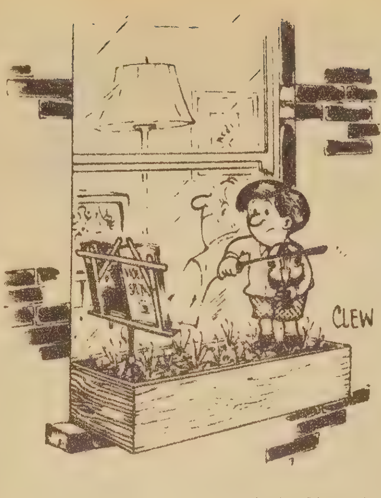
e song titles presented on the disc
Young and Foolish—They Call The
Maria—Unchained Melody—Let
Rest Of The World Go By—I Don't
If The Sun Don't Shine—Secret
—Great Day—The Life That I
—I'm Old Fashioned—Old Devil
n—Alone Together—A Cock-Eyed
nist. (K.W.)

* * *

**-TIME COUNTRY AND WES-
TERN HITS. The Nashville All
Stars. Reader's Digest-R.C.A.
Dynagroove, Stereo CSP-114.
Available only from Reader's
Digest Association Pty. Ltd., Box
65, G.P.O., Sydney.**

Interest: Country and Western.
Performance: First-class.
Quality: Excellent.
Stereo: Wide separation.

is latest release in the Reader's
st series of single LPs selling at the
price of $1 each has all the good
s of the earlier releases—top name
ormers, popular material and ex-
nt technical quality. By what com-
ial wizardry the company is able
to market these discs at this price is not revealed, but for the record buying public they represent a windfall not to be passed up.



—"TV" Times"

The recording was taken at Nashville, Tennessee, the "Mecca" of folk singers in U.S.A., and features such seasoned performers as Ray Edentone and Jerry Shook (rhythm guitars), Jerry Reed and Peter Wade (electric guitars), Lloyd Green (steel guitar), Buddy Harman and Willie Ackerman (drums), Charlie McCoy (harmonica) and Hargus Robinson with Jerry Smith both playing piano. With this line-up one is entitled to expect, and gets, a first-rate performance.

The titles are: Tennessee Border—I'm Movin' On—Bouquet of Roses—You Don't Know Me — Walking the Floor Over You—Room Full of Roses—Rag Mop—Please Help Me, I'm Falling—Sugarfoot Rag—Just a Little Lovin'—Anytime — I Don't Hurt Anymore. (H.A.T.)

* * *

GEOFF TANGLE-TONGUE MACK, and his Mack-anicks. Mono, "Spin" (Festival) EL-31,911.

Interest: Comedy vocal.
Performance: Entertaining.
Quality: Good.

My first impression of Albert Geoffrey McElhinney, to give him his full and considerable name, was an Aussie version of George Formby. But, as the tracks progressed I scrubbed this for a "Rolf Harris plus group" impression.

And this isn't far from accurate.

Geoff Mack, who composes as well as performs his songs, is quick of wit, nimble of tongue, penetrating in his humour and adept in his musical arrangements. How's this for a range of subjects: I've Had Everything (a clever parody of I've Been Everywhere) — Corrugated Rhythm (a skit on country roads) — Double Headed Penny (Two-up and all that) — The Snake That Didn't Like Music (Indian touch) — I'm Gonna Buy Me Mother-in-law a Block Of Land On Mars (filial affection) — Hot Rod (with sound effects) —Give It A Go, Joe — We'll All Go Up and Down The Mountain — Makin' Love Injun' Style (Hiawatha music) — Arunta The Hunter (Joliffe set to music) — One-Armed Bandit (R.S.L. Clubs, etc.).

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Frequency response plus/minus 2 db 10-100,000cps
Signal for rated power output
Mag. Phono at 1 KC (Standard RIAA) Equalisation 2mv
Tuner Input .. .. 100 mv
Tape (RCDR) Input .. .. 100 mv
Tape Output .. .. 100 mv
Min. recommended load resistance on tape out .. .. 25k ohms
Speaker Output Impedance .. 4, 8 and 16 ohms

Hum and Noise:
Signal to noise ratio (loudness control at min.) .. .. —80db
Tuner Input .. .. —78db
Tape (RCDR) Input .. .. —78db
Mag. Phono (Standard RIAA) .. —55db
Stereo Separation (at 1 kc)
Phono Magnetic 65db
Tuner 65db
Tape Input 65db
Tone Controls:
Treble at 10 kc .. 10db boost; 15db Cut
Bass at 50 cps .. 15db boost; 15db Cut
Contour: Up to 10 o'clock .. max. 5db boost, at 50 cps
Past 10 o'clock .. .. response linear
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Power Consumption at 240 Volts, 50 cps:
Idling .. .. 10 Watts
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Encel price is only

$129

(£64/10/-)

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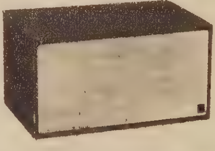
WHAT IS AN EMQ?

Because of trade agreements many prices cannot be advertised so we advise you to write to us for an EMQ . . . an Encel Mail Quote. Please print your name and address in BLOCK LETTERS . . . and, if you're writing for amplifier or tape recorder information, please be reasonably specific as our stock of these items is extremely wide. Help us to help you!



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As Australian Agents, Encel Electronics are proud to be associated with these famous American amplifiers. The first two Acoustech shipments were sold out within two days of arrival in Australia! Of particular interest is the Acoustech Model V, an integrated solid state stereo amplifier with an output of 45 watts RMS per channel — at rating applicable throughout the extended frequency range. This model is priced at **$350**

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Many types of SARLON acoustic fabrics
now available at Encel Stereo Centres . . .
to see them! Several types are of partic
interest to the ultra modern home owne

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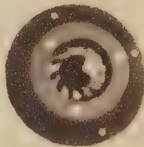

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acitor which E
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sponse of the HF
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Two "Sonics" five speaker systems are speci
for this budget priced Encel Stereo Syst
The stereo amplifier is the well known
SA-30, the turntable a Labcraft belt drive,
cartridge a B and O magnetic unit with a
mond stylus. Price is only **$195.** The spea
enclosures house four 6½" speakers and a 2
tweeter and are finished in oiled teak or wal
If you wish to include the new Encel CSM
stereo amplifier instead of the SA-30,
the price is still only **$2**

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The U.K. shipping strike slowed supplies
audio equipment from British manufacturers
consequently some mail orders were dela
Please accept our apologies!

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Encel Electronics recommend this famous S
recorder. Three motors are featured in
versatile two-speed professional quality recor
ask for an EMQ or a trade-in valuation
your old unit. See Encel Stereo Centres f
Revox demonstration . . . the price will plea
ly surprise you!

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now on display at Encel Stereo Centres .
and individual prices are as low as $25.
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enthusiast who wishes to up-grade spe
quality, "Sonics" offer unusually good va
Cabinets are hand finished in oiled teak
walnut veneers. **Model AS 302** features a
bass reproducer and a horn type tweeter
variable brilliant control .. **$47 (£23/1**
Model AS-60 two speaker system .. ..
(£12/10/). **Model AS-41** 3 speaker sys
2 woofers and a tweeter . . . **$31 (£15/1**
Several others in stock. Come to your nea
Encel Stereo Centre and hear the "Son
range!

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Australia's Greatest Hi-Fi Centre

the performance could be criticised, uld be that the high-speed rhythm etes too vigorously with the high- lyrics but, then, maybe it's meant that way.

casional tracks from this one should your guests in a good mood! .W.)

★ ★ ★

LINDSAY'S NATIONAL COUN-TRY AND WESTERN HOUR. Festival, Mono FL-31,945.
nterest: Recorded version of TV how.
Performance: Lively.
Quality: Very good.

is recorded version of the popular Lindsay's Country and Western " which is featured on television ns all over Australia will have us appeal to those who watch the y show. All the regular entertainers who take part in the show are represented. Reg Lindsay himself sings "Life of a Poor Boy" and "Shade of the Blues" solo, and joins with Heather McKean in singing "Now Tell Me" as a duet. Heather McKean also sings "You Don't Find a Good Man Every Day" while Jill Freeman contributes "Tennessee Wigwalk."

The rest of the program consists of "Blackboard of my Heart" and "I'd Like to Be" from Jimmy Little; "I Heard the Bluebird Sing" (Rick and Dennis); "Wild Side of Life" (Ray Brown); "Allentown Jail" (The Del Rios); "Fly Trouble" (Bob Hardie).

This group of lively and talented performers show why this is one of the most popular locally produced television programs. The sound quality is also very good. All in all, a very good disc, for those who like country and western style music. (H.A.T.)

POPULAR JAZZ

Reviewed by GRAEME BELL

TIME JAZZ GREATS. Re-record-ngs of Tommy Dorsey, Jimmy Dorsey, Jack Teagarden, Johnny Mercer, Joe Venuti and Hoagy Car-michael, with an introduction by Paul Whiteman. Universal Record Club UJ-776.
nterest: Mostly dinner music.
Performance: Professional.
Quality: Good.

title is very much a misnomer. re told that this album comprises eatest combination of performances performers ever achieved in the ar recording field, but on listening disc, there is nothing to confirm xtravagant statement.

you are looking for jazz, then you find more than two or three ses here, and they are nearly all Jack Teagarden.

wever, it is a pleasantly unobtrusive , suitable for background music you have something more meaty k about.

★ ★ ★

RY JAMES. The Ballads and The Beat. Dot Records, Stereo SZL-31,862. Also available in Mono.
nterest: Trumpet.
Performance: Excellent.
Quality: Brilliant.
Stereo: Normal spread.

re's a rather good idea — ballads e side, and bright numbers with a on the other.

e of the greatest trumpet tech-s of our time, Harry James here ys his big range and sure attack, or my money, comes up best on beat" tracks.

have always found his wide altzy vibrato in some of his ballads e corny side, but on "Girl Talk," he uses a mute, his approach is ly different and this track displays of the best arrangements.

at great big-band drummer, Buddy leads the rhythm section, which, with its added Latin instruments, shines in "Malaguena Salerose" and a fast version of "Cubana Chant."

No other personnel are given, but the orchestral performance and arrangements are excellent, and recording quality truly ultra high-fidelity.

★ ★ ★

THE GLENN MILLER STORY—Music from the Film Sound Track, plus two numbers from LOUIS ARMSTRONG and the ALL STARS. New World of Sound, Festival Records, Stereo SDL-931, 887. Also available on Mono.
Interest: Glenn Miller and Louis Armstrong.
Performance: Good.
Quality: Good.
Stereo: Well spread.

The Universal-International Studio Orchestra has done an amazing job in recapturing the basic characteristics of the Miller style for the motion picture of the life story of this great bandleader, whose life was cut short in World War II when, as an officer in the U.S. Army, his plane disappeared over the fog-shrouded English Channel.

Most of the old favourites are there, such as "Tuxedo Junction," "Little Brown Jug," "In The Mood," "A String Of Pearls" and "American Patrol."

The two items by Louis Armstrong, who played in a spectacular scene in the film, were specially re-done in the Decca Studios, and the sleeve notes tell us that Decca assembled among others " —Trummie Young as first trombonist and, of course, Louis himself as first trumpeter and leader." (!)

The titles are "Basin Street" and "Otchi-Tchor-Ni-Ya," and there is no small amount of excitement generated here, especially on the latter track.

The quality of these two studio tracks does not appear to be as good as the big band sound tracks.

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ALEN PRICE PHOTOGRAPHIC, Shop 20, 50 George St., Parramatta, N.S.W.
MEECO, Smith St., Maracoote, South Australia.
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*MDF-600B cardioid microphone

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s±8 dB
†Sensitivity : −52 dB±3 dB,
Dimensions : 148×48×34.5 mm without stand
Cable : 4 ϕmm, 3 m
Weight : 1¼ lbs (525 g)

DF-1DE

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 150~10,000 c/s±8 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 385.5 mm high
21 mm diameter, microphone
128 mm diameter, stand
Cable : 4 ϕmm, 1.5 m
Weight : 1⅞ lbs (840 g) with cable

*DF-14B

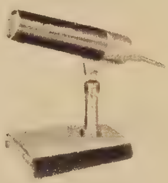
SPECIFICATIONS
Impedance : 50 kΩ Variable
Frequency Response : 100~10,000 c/s±8 dB
†Sensitivity : −48 dB±3 dB,
Dimensions : 136×75×47 mm
Cable : 6 ϕmm, 4 m
Weight : 2 lbs (900 g)

*DF-22B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 50~12,000 c/s±7 dB
†Sensitivity : −57 dB±3 dB,
Dimensions : 32.5 mm diameter, 220 mm long
Cable : 6 ϕmm, 4 m
Weight : 1¼ lbs (575 g)

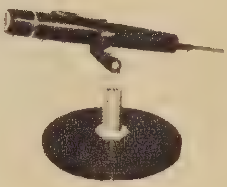
DF-1/*DF-1B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s±
†Sensitivity : −57 dB±3 dB,
Dimensions : 21 mm diameter, 82.7 mm
Cable : 3 ϕmm, 1.5 m
Weight : 3.9 oz (110 g) with cable



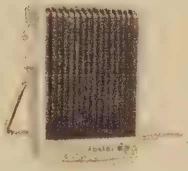
DF-3

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 50~12,000 c/s±8
†Sensitivity : −56 dB±3 dB,
Dimensions : 33.5 mm diameter, 133 mm
Cable : 4 ϕmm, 1.5 m
Weight : 9.0 oz (255 g) with cable



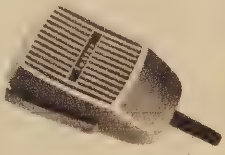
DF-12/*DF-12B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 80~12,000 c/s±8
†Sensitivity : −57 dB±3 dB,
Dimensions : 23 mm diameter, 158 mm
Cable : 3 ϕmm, 1.5 m
Weight : 6.3 oz (180 g) with cable



*DF-2B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 100~10,000 c/s±1
†Sensitivity : −56 dB±3 dB,
Dimensions : 75×53×30 mm
Cable : 3 ϕmm, 1.5 m
Weight : 4.8 oz (136 g) with cable



*DF-51B

SPECIFICATIONS
Impedance : 50 kΩ
Frequency Response : 150~8,000 c/s±7
†Sensitivity : −57 dB±3 dB,
Dimensions : 98×58×36 mm
Cable : 6 ϕmm, 1.6 m, Coiled
Weight : 7.3 oz (207 g) with cable

* with switch : † at 1,000 c/s, 0 dB=1 V/μ bar

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TRADE REVIEWS AND RELEASES

RADO "SOLID STATE" STEREO CARTRIDGES

lessrs H. Rowe and Co. Pty. Ltd. recently submitted for review amples of a new range of so-called "solid state" stereo cartridges. 'hough they could probably be described in more familiar terms as eramic cartridges, they have been developed to a point where they re able to sell in direct competition with the many and esteemed magnetic units currently available.

were most interested to receive the dges since, if the manufacturer's were to be taken at face value, they be of considerable interest to high y enthusiasts.

ving out the advertising superlatives, aims boil down to (1) flat frequency ise over the range 10 to 50,000Hz; annel separation averaging 20dB; (3) y high compliance, 25 microcenti- /dyne; (4) optimum tracking force ams; (5) suitable for connection to l magnetic input of pre-amplifier.

transducers are described by the acturers as "two subminiature lamin- olid-state generators" and, in view of rther statement that "the cartridges n no coils, magnets, silicon diodes or tors," it is reasonable to conclude hey are basically piezo-electric types, ceramic materials.

ormance can be assessed readily h, of course, but time and experience can validate the manufacturer's fur- onviction that their new "solid state" ges offer a bonus in terms of rugged- nd long life.

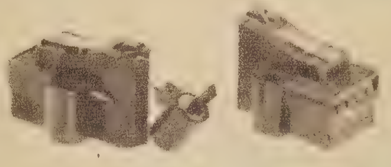
range of the cartridges available at t consists of (1) Model BE, with al diamond stylus, retailing at $39; odel BR, which we understand is lly the same as the BE, but fitted round stylus, selling retail at $22.50; odel BT/R, fitted with round dia- stylus, and which we assume is not to the exacting specifications of the priced types, since it sells for only tail.

essories available include a record ng brush, which is fixed to the front cartridge to minimise dust damage ord and stylus, and a special stylus ply for use with 78rpm records.

mentioned above, the cartridges are be suitable for direct connection to rd magnetic pre-amplifier inputs, we take to mean an input impedance ut 47,000 ohms. But here a word of to owners of transistorised equip- with only a few thousand ohms input nce: While their equipment will work torily with "medium impedance" tic cartridges as normally available, not follow that these piezo-electric an be fed directly into the same low nce input; severe loss of bass would ly result.

s on the sample cartridges in our own ory generally confirmed the findings published in overseas magazines. onsensus of opinion is that, al- the claims of the manufacturers solutely flat frequency response from 50,000Hz" are optimistic, the two priced units are indeed capable of od performance.

the Vanguard test record VSD-100 e cartridge feeding into a preampli- mpensated for the RIAA character- esponse was substantially flat over ire middle range of frequencies. At end, around 30Hz, there was evi- of a slightly rising characteristic which would relate, in some degree, to the characteristics of the particular arm. At the treble end, there was a droop of minus 2 or 3dB at around 12KHz, rising again towards reference at around 15KHz, in a manner which would suggest a well damped system resonance in this region.



Two of the new cartridges and, between them, the groove brush which is offered as an accessory.

Balance between channels was extremely good, being within 1dB over most of the frequency range covered by our tests.

Channel separation (cross talk) is negligible up to 10KHz, and we would not quarrel with the manufacturer's claim of average 20dB separation. As is to be expected, the figure drops sharply beyond 10KHz until, at the resonant peak of 15KHz, separation is virtually non-existent. Loss of separation, approaching the system resonance, is evident in most pickups, however.

With compliance rated as 25 microcentimetres per dyne, we were not surprised to find that the tracking ability of the cartridges was extremely good. Tested on the most heavily modulated track on the test record (8dB above standard recording level) there was only the merest trace of distortion of the oscilloscope waveform. Since this degree of modulation is likely to be encountered rarely in normal recordings, it is safe to assume that the Grado BE and BR cartridges will faithfully track the loudest passages with negligible distortion.

A feature of the design is the ease with which the stylus can be changed. A small brass clip holds the stylus assembly in place, and it is only necessary to swing this clip to one side to remove the old stylus assembly and replace it with another. One advantage of this, as far as owners of 78 rpm records are concerned, is that the special stylus assembly designed for 78rpm discs can be easily inserted when required.

At this point it might be as well to mention that replacement styli are by no means cheap. Advertised retail prices are $26 for the BE elliptical stylus, $13 for the BE round stylus, and $9.75 for the stylus of the cheaper BT/R cartridge.

While the Grado cartridges are not susceptible to magnetic hum fields, they do show some sensitivity to electrostatic hum pickup. Assuming that normal care is taken with shielding of leads and connections, hum is not likely to be a problem under ordinary playing conditions.

Having completed our tests on the two higher priced models, we turned our attention to the low priced Model BT/R. In their claims for Grado cartridges, the manufacturers appear to have applied them to all models of the range. We felt that, if they had produced a cartridge selling for only $15 with a performance anywhere near as good as that of the two models already tested they would really have a winner!

Unfortunately, it turned out otherwise, at least with the particular sample at hand. The frequency response did not show up nearly so well under test as the higher priced models. While reasonably flat over the middle range of frequencies, there was considerable unevenness at the extremes. Rolloff began at about 5000Hz and from 10KHz there was a sharp rise to the resonant peak at 15KHz.

On the other hand, channel balance was again extremely good, being within 2dB over the entire range tested. Tracking was only slightly below the excellent performance of the higher priced models. At the 8dB level, there were signs of flattening of the sine wave peaks as observed on the oscilloscope; at the 6dB level there was no noticeable distortion.

But, despite the good performance of the cartridge in these respects, it can scarcely be classed as a high fidelity unit, because of the inferior frequency response. (H.A.T.)

STC "TAG" SOLID TANTALUM CAPACITORS

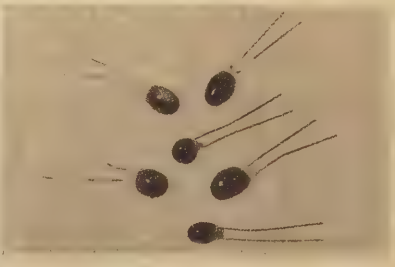
Standard Telephones and Cables Pty. Ltd. have advised that they now hold good stocks of their new range of low-cost solid tantalum "TAG" capacitors.

The internal construction of these capacitors is similar to the established DEF 5134 patterns, but they are dipped in a moisture resistant resin to give mechanical protection.

In the manufacturing process, high purity tantalum powder is sintered to form a cylindrical body of controlled porosity, providing a large internal surface area. A tantalum pentoxide layer is electrochemically formed over the whole of the internal surface, contact to this layer being a solid manganese dioxide semiconductor of high density and good conductivity. The cathode connection is formed by a graphite coating over the outside surface.

Electrical characteristics of the TAG range are: capacitance range—0.1 to 50uF; capacitance tolerance—minus 20 per cent to plus 50 per cent; temperature range—minus 40 to plus 85 degrees C; working voltages—3V to 35V DC.

Solid tantalum capacitors have grown rapidly in popularity, especially since the introduction of low-cost types. Advantages claimed for tantalum capacitors over the conventional aluminium electrolytic types are:

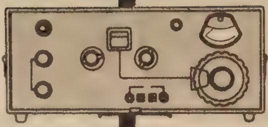


Better power factor, and greater stability with temperature and time.

Longer shelf life without reforming, and longer overall life.

Wide operational temperature range.

Specially suitable for printed wiring board mounting. Single-ended lead-out wires and colour coded insulated case.



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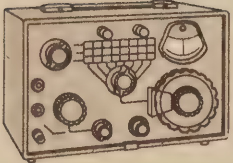
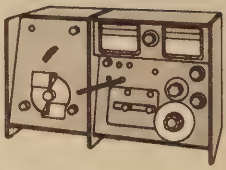
BRIDGE
TYPE TF2701

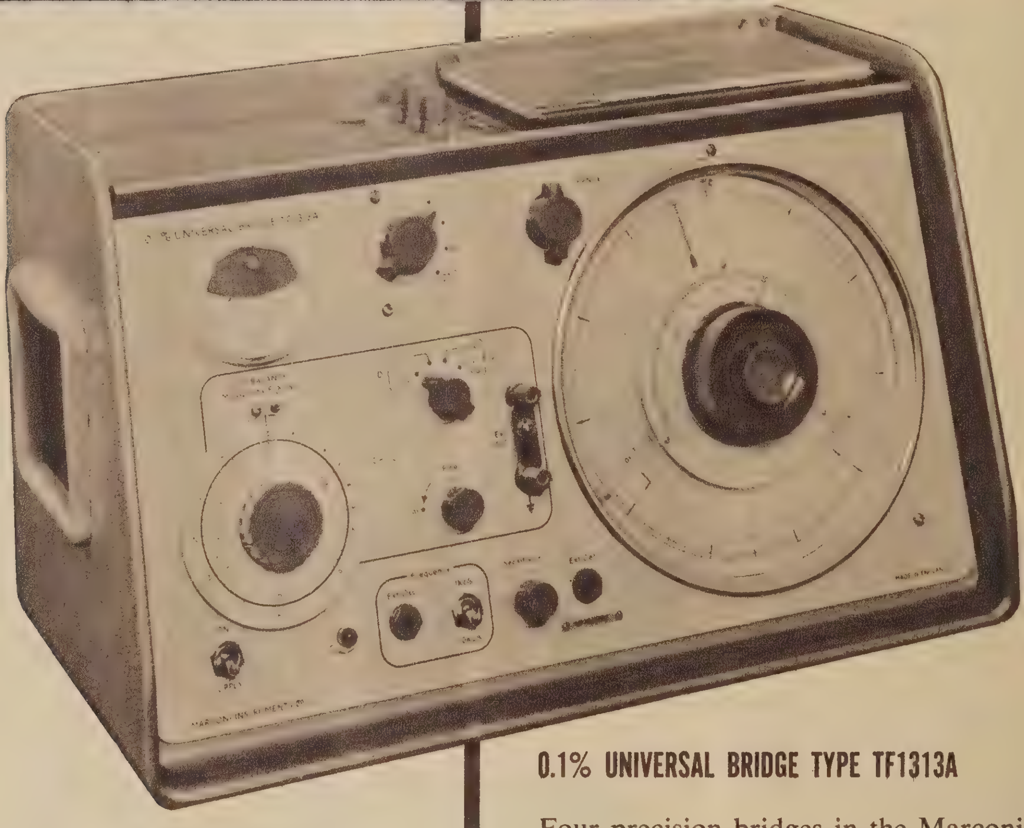


UNIVERSAL
BRIDGE
TYPE TF2700



CIRCUIT
MAGNIFICATION
METER
TYPE TF1245

Z + C + L + R + ε + Q + D . . .



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TRADE RELEASES IN BRIEF

THE MINIWATT DIVISION of Philips ectrical Pty. Ltd. is manufacturing two w transistor types, the BF167 and BF173, hich, the company says, employ a novel chnology developed by Philips. The new chnique allows silicon planar transistors be made with a significantly lower value feedback capacitance, says Miniwatt.

The application of this "integrated screeng" technique results in HF transistors ith a very high figure of merit compared ith conventional silicon planar transistors d permits the construction of high-gain nplifiers without necessity for neutralisaon.

The BF167 is recommended as forward ain controlled first transistor (control range 0dB) and the BF173 as second and third ansistor in a three-stage video IF amplifier otal gain in excess of 90dB).

Further details are available from Miniatt Division, 20 Herbert Street, Artarmon, .S.W.

FAIRCHILD AUSTRALIA PTY. LTD. as extended its range of NPN special haracteristic devices with the addition of 6 new types.

2N2060/2N2223/2N2223A NPN Differenal Amplifiers are six-terminal devices each ontaining two isolated high-gain NPN ouble diffused silicon planar transistors in ne hermetically sealed enclosure. They are esigned for high performance differential mplifier circuits.

SE5020/21/22/23/24 NPN RF-AGC Ampifiers are silicon planar RF transistors with ain, bandwidth, noise characteristics and ackage suitable for high-performance TV pplications.

2N998/2N999 NPN Ultra-high-gain Comound Amplifiers are four-terminal devices, ach containing two high-gain silicon planar ransistors connected as a Darlington comound amplifier in one hermetically sealed nclosure. Fairchild say these devices are articularly useful in circuits requiring very igh gain and high input-impedance and, n the case of the 2N998, low noise. A ourth lead is provided which makes all erminals of both devices accessible.

SE5050/SE5051 NPN RF Amplifiers feaure low feedback, low noise figure, high ower gain and forward AGC.

3N87/3N88 NPN High-speed Choppers re four-terminal, dual emitter integrated evices designed to give nearly identical urrent gains, voltage offsets, and thermal rift characteristics. Fairchild recommend hem for low level chopper and commuting pplications.

AY8105/6 NPN Medium Power Silicon lanar Transistors are epitaxial transistors esigned for medium power applications.

2N3923 NPN High Voltage Amplifier is silicon planar transistor designed primarily or use as a high voltage output device here low collector/base capacitance is equired.

Data sheets with technical details of these ransistors can be had on application to airchild Marketing Services Group, 420 Mt. Dandenong Road, Croydon, Victoria.

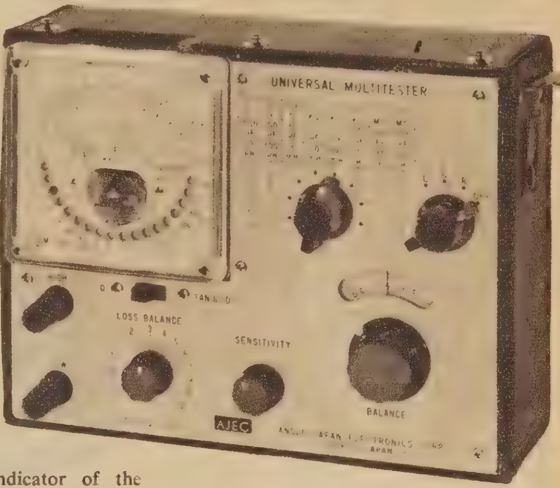
FERRIS BROS. PTY. LTD. have apointed Mr R. (Bob) Rae New South Wales ranch Sales Supervisor, in succession to Mr R. A. Baker, who resigned recently. lso, Mr Ray Platt has been appointed .S.W. Sales Representative.

FAIRCHILD AUSTRALIA PTY. LTD. as established a new office in N.S.W., at uite 22, A.M.P. Building, 20-22 Macquarie treet, Parramatta, telephone 635-4088. Fairhild's N.S.W. Engineering Representative, Mr Trevor Andrews, is now based at this ddress. A large range of silicon planar emiconductors are available ex stock at his office.

(Continued on Page 147)

COMBINATION MULTIMETER, L-C-R BRIDGE

University Graham Instruments Pty. Ltd. recently submitted an AJEC Universal Multi-tester for examination by our technical staff. This instrument, shown in the accompanying photograph, combines a sensitive multimeter with a R.L.C. bridge.



The multimeter section has six DC voltage ranges covering from 0.25V full scale to 1000V full scale. Sensitivity on these ranges is 20,000 ohms per volt. The five AC voltage ranges have a sensitivity of 8,000 ohms per volt. DC current ranges cover from 50uA full scale to 250mA full scale. Four resistance ranges allow measurements to be made from very low values up to 50 megohms — altogether a generous coverage.

The range in use is selected by a knurled knob protruding from the top of the meter, and indicated directly on the meter face.

The meter movement of the multimeter doubles up as the null indicator of the R.L.C. bridge, the functions of bridge or tester being selected by a slide switch on the side of the instrument. As a bridge, the measurement ranges available are: Inductance 0.1uH to 110H (8 ranges); Capacitance 1pF to 1100uF (8 ranges); Resistance 0.01 ohm to 11 megohm (8 ranges) again generous coverage.

The bridge energising source is an inbuilt 1KC transistorised oscillator.

Operation of the bridge is quite simple and needs very little practice to achieve accurate readings. However, there are one or two points which could be improved: The balance control setting is inclined to be touchy and the need for a vernier drive on this control is evident. There is also some type of time constant involved in the meter read-out as it is necessary to wait for the reading to settle whenever an adjustment is made to the balance control.

Mechanically, the equipment appears to be quite robust and the wiring excellent. The only criticism that we could make in this regard is the requirement to solder two of the three batteries into the circuit. This could be a nuisance when changing batteries. Also the provision of a better battery container would be wise to minimise possible damage by leaking batteries. The batteries used are standard types, 006P (9V) BL-005 (22.5V) and UM-3 (1.5V).

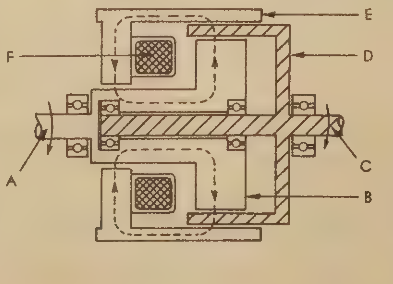
While the instrument is not claimed to be a substandard, the tests carried out in our laboratory proved it to be quite accurate and substantially agreed with the manufacturer's figures.

All in all, it is a handy instrument for multi-purpose testing and reasonably priced at $106.00 plus sales tax. University Graham Instruments Pty. Ltd., 106 Belmore Road, Riverwood, is the sole Australian distributor and advise that the Universal Multitester will be available through agents and wholesalers. (K.W.)

TORQUE AND SPEED CONTROL UNIT (TASC)

Details of a new torque and speed control unit for electric motors have been sent by the manufacturers, F. W. Davey and Co. Pty. Ltd., 288 Huntingdale Road, Huntingdale, Victoria.

The TASC unit, as they call it, is an electro - magnetic induction coupling, consisting of an input shaft (a) driven by an AC electric motor or other prime mover, connected to a rotor (B) which has radially disposed poles. Surrounding this rotor and fixed to the output shaft (C) is an aluminium or copper torque tube (D). There is no mechanical connection between the input and output sides, and thus the only mechanical wear in the unit takes place in the sealed ball bearings. A fixed frame (E) surrounds the two moving members and carries a stationary coil (F). This stationary coil is one of the salient features of the design, because it eliminates the need for slip rings and brushes.



When current is passed through the coil, the magnetic field is set up as shown in the diagram. This induces currents in the torque tube (D) and thus a second magnetic field is created around the torque tube. These magnetic fields interact to produce torque in the torque tube, which tends to drive it in the same direction as the poled rotor. The magnitude of this induced torque is approximately proportional to the current passed through the coil, and nearly independent of speed. The TASC unit is thus intrinsically a controlled torque device.

The TASC unit has been developed primarily for speed control of electric motors, and three different speed control systems cater for varying requirements, all employing the basic principle of comparing voltage from a tachogenerator on the output shaft with the voltage from a manually operated potentiometer.

Other standard control systems are made to fulfil a requirement where (a) a speed is required to change in proportion to the speed of another shaft, or the position of a tool relative to the centre of the work on a lathe, or (b) the torque is required to change in relation to diameter, as in winding operations. Other control systems for specialised operations can also be supplied.

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This is more than twice the output of most tape recorders available at present. Ideal for use as a Hi-Fi AMPLIFIER. Ready to connect to any record player. Record changers in portable matching carrying cases available.

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Price includes dynamic Mic, Tape and Spool

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- Beautifully styled timber cabinet.
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- Monitoring through speakers.

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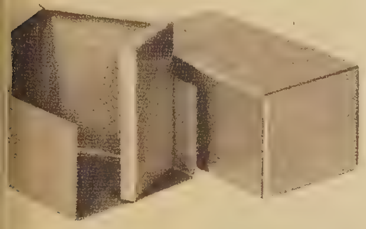
ADE IN BRIEF — cont.

IALGAMATED WIRELESS VALVE PTY. LTD. have announced avail- y of the following new products from : TA2701 is an insulated full-gate effect (MOS) transistor for chopper cations. A developmental silicon N- nel depletion type, it has a maximum rating of 25V, maximum drain cur- of 30mA and dissipation of 150mW. 769 is another developmental N-chan- depletion-type silicon MOS transistor intended for audio and wide-band am- r applications. Ratings are generally ar to the TA2701 above. TA2672 is manium PNP power transistor for high ty audio amplifier applications. An -junction type, the TA2672 is claimed ive high current and dissipation charac- ics with exceptional linearity over the range of collector current. Typical r from a single-ended push-pull pair 5 watts RMS at 5% THD.

etails of these products are available the AWV Head Office, Postal address ivate Mail Bag, Ermington, N.S.W.

. ROWE & CO. PTY. LTD. advise they can now offer the MK II "Vari- ' a small electronic light dimmer for itrave mounting. Coming complete face plate, control knob and isolating ch, it provides gradual control to a imum of 500 watts. It sells for $20.95, same price as the MK I model, which a rating of 750W. The Varilites are able for use with incandescent lighting '.



llustrated above are two metal oxes suitable for small projects uch as the small battery chargers lescribed in our issues for May ind June, 1966. These boxes and netalwork for most "ELEC-TRONICS Australia" projects are carried by Messrs Heating Systems Pty. Ltd., 97 Marriott Street, Redfern, N.S.W.

MALGAMATED WIRELESS (AUS- ALASIA) LTD. announce the release a number of "Solid-State Test Sets," in- ded for use in specific situations. Test A-211 combines a high quality signal erator and an AC millivoltmeter cover- the range 10Hz to 50KHz; it provides ilities for the evaluation of audio and ersonic amplifiers, filters and transmis- n circuits. Test Set A-310 contains RF AF signal generators, power meters, dulation and field strength meters and intended to facilitate maintenance of HF lio communication equipment. Test Set 410 contains the necessary equipment for ting FM transmitters and receivers in the IF and UHF bands. Details are avail- e from the Engineering Products Divi- n, AWA, 47 York St, Sydney.

FAIRCHILD AUSTRALIA PTY. LTD. int out that monolithic integrated circuit rays are quite feasible with as many as 500 components on a chip ¼-inch square. l the circuitry associated with as many as 0 transistors and hundreds of resistors d diodes can be compressed into a space ual to that normally required by a single ansistor. There are major problems, how- er in reconciling all this compressed cir- itry with the needs of engineering customers. who have to incorporate it in user products. To define and solve these problems, the Fairchild Company in U.S.A. is entering upon a year-long research program "to develop specifications, product descriptions and total interface solutions to manufacturer-user problems inherent in the application of complex monolithic integrated circuit arrays."

ROLA COMPANY (AUSTRALIA) PTY. LTD., a member of the Plessey Components Group, advises that Mr A. K. Box has retired as Advertising Manager. "Boxie," as he is affectionately known, was in charge of the Rola Company's advertising and promotional activities for 20 years. One of his big successes was the "Rola Radio Newsreel" which, at its peak, had an audience rating of 650,000 listeners. Mr Box served with the 6th Div. A.I.F., and was one of the original "Rats of Tobruk."

PLESSEY AUTOMATION, DATA HANDLING DIVISION, have developed a remote control and telemetry system called Dictum 11. The result of some 6 years' development, the system is intended for use by public authorities or industrial complexes. Dictum 11 operates by providing an encoding and decoding facility for

(Continued on Page 148)

6-INCH SPEAKER FROM PHILIPS

The Miniwatt Electronics Division of Philips Electrical Pty. Ltd. has submitted for review a sample of a new 6in twin-cone speaker, the "Minuette" (Type AD3701PM).

This is one of a complete range of loudspeakers that Miniwatt is importing. We understand the company intends to carry out an extensive local development program to design suitable enclosures in line with current Australian trends. Details of an enclosure specifically designed for the "Minuette" speaker by the Philips parent company in Holland can be had on request.

The manufacturer's data sheet shows a frequency response of 45-19,000Hz, flux density of 9,500 gauss and cone resonance of 50Hz. Retail price is $15.00, and usual trade discounts apply.

This specification is quite impressive for an expensive speaker of this type. Tested as a single speaker unit we found that it performed very well, and results were quite as pleasing as from any other small, wide-range loudspeaker we could recollect.

On this basis, we expected that excellent results would be obtained by combining the unit with a tweeter and crossover network. This impression was fully confirmed when we mounted the speaker, with a Rola 5in tweeter and 2.5KHz crossover, in our "Bookshelf" enclosure.

Operated in this way, we found it very difficult to detect the difference between this unit and one of the original Bookshelf prototypes. Frequency response appeared to be smooth and clean over the entire audible range, with no obvious intermodulation distortion or other undesirable effects.

In close listening tests, with the aid of a changeover switch, some slight differences in sound quality were noticed, and we concluded that the bass of the Philips was slightly more prominent while the middle range of frequencies was slightly less so. Some of our staff members preferred this to the performance of the original, but all agreed that the differences were marginal.

We located the natural cone resonance at around 65Hz, which did not entirely agree with the manufacturer's figure of 50Hz. When mounted in our Bookshelf enclosure, resonance rose to about 95Hz, but it was much more evident on impedance measurement than as a variation in acoustic output.

Our sample had a voice coil impedance of 15 ohms, but alternative versions can be supplied with 7 ohms impedance or, for high impedance transformerless output valve circuits, with 800 ohms. The power output rating is 10 watts in a suitable sealed enclosure.

Pricewise, the "Minuette" is fairly competitive with other high-quality speakers of the same size.

To sum up, this speaker is a good performer at a competitive price. We regard it as quite suitable for use in our own Playmaster Bookshelf system, performs as well as others we have tried, and was preferred by some staff members. In Philips' own and somewhat larger enclosure design, it may well perform even better, but we have not had the opportunity to test it under these conditions. (H.A.T.)

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- Switch contact capacity 1500 watts at 240 volt AC 50-cycle.
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- Dial face calibrated in black for 12-hour (normal clock face) and in red for 24-hour period.
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GAS-FUELLED THERMOELECTRIC GENERATOR

A thermoelectric generator, based on the Seebeck thermocouple effect, is available in Australia from Astronic Imports, who have been appointed exclusive agents by the manufacturers, General Instrument Corporation, of U.S.A. We had not had the opportunity to see the device in operation, but the following information is extracted from the manufacturer's literature.

The unit is designed to operate from natural gas, such as Propane or Methane. Heat for the thermocouple is provided by the catalytic "burning" of the gas at a temperature well below the ignition point of the gas. This means, in effect, that the gas is consumed without flame, by low temperature oxidation; nevertheless, heat is produced in the process.

The thermocouples use bismuth-telluride elements which give maximum power output at a hotplate operating temperature of 500-550 degrees F.

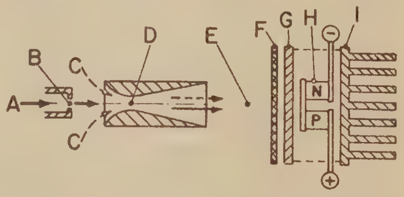
Generators are available with capacities ranging from 4.2W to 72W. Thermoelectric generators are basically low voltage devices, and, for most practical applications, voltage must be raised by DC to DC converters. Nominal 12V or 24V converters are standard, but units with other output voltages can be supplied.

Generating costs are by no means low, as the generator requires about 7lb of propane gas to deliver one kilowatt-hour. However, the unit is not intended to be a general purpose device for intermittent use, but a high reliability power source in situations where running costs are not a primary consideration; for example at unattended transmitter sites in communication systems or for use with equipment engaged in remote data gathering.

The unit is said to be maintenance free, since there are no moving parts, and the thermoelectric modules are hermetically sealed. The absence of friction from moving parts makes lubrication unnecessary.

The flameless "combustion" cannot be extinguished by high winds or other adverse weather conditions, and the manufacturers state that the equipment will operate satisfactorily in winds up to 120 m.p.h. Heat generated within the unit itself keeps it free of snow and ice, when these conditions are encountered.

Illustrated is one of the TELAN series of thermoelectric generators made by General Instrument Corp. These units have 9W elements.



The operating principle of the thermoelectric generator is illustrated in this diagram. Gas is injected through the orifice at B. As the gas enters the venturi (D) it draws in with it primary air (C). The gas and air mixture enters the mixing chamber (E) and impinges on catalytic screen (F) where low temperature oxidation and heat release occur. Heat collected by hotplate (G) is transferred to base of thermocouple (H), while air convection by cooling fins (I) cools reverse side of thermocouple. The temperature difference across the thermocouple is converted into voltage.

TRADE IN BRIEF — cont.

transmitting information on a number of parameters to be measured, together with any appropriate control instructions. Transmission may be over physical circuits or other transmsision channels such as radio carrier. Information about Dictum 11 may be obtained from Plessey Automation, 13-17 Botany Rd., Redfern, N.S.W.

BRITISH MERCHANDISING PTY. LTD., 60 Clarence Street, Sydney, are Australian agents for Jackson Bros (London) Ltd., who have recently introduced a new range of variable capacitors and precision drives suitable for tuning high-quality radio receivers and communications equipment.

Typical of the variable capacitor range are the Type 005 variable capacitor, intended for superhet transistor receivers, with two AM sections, three FM sections and 3:1 reduction gearing in a frame measuring only 1-3/8 x 1¼ x 1-11/16in, and the Type P.22 two-gang variable capacitor which is available with either two 510pF AM sections or 350pF AM section and 10pF FM section, frame size 2¼ x 1-7/10 x 1-5/8in.

The precision drive range includes the G.80, with 10:1 friction drive and 8:1 gear drive in series, giving an overall reduction ratio of 80:1. The friction drive consists of two phosphor-bronze discs gripping a small steel flange on the input shaft. This arrangement is said to eliminate lost motion but to allow slip to protect the unit from damage under excessive torque.

Another precision drive, intended mainly for commercial receivers, is the 6B/36 which consists of two epicyclic ball-drive units in series, the second restricted to 300 degrees angular movement, after which it transmits direct drive. This enables the output shaft to be moved rapidly at 6:1 ratio to an approximate position, them reversed at 36:1 ratio for fine tuning.

GEMCO ELECTRORAIL PTY. one of the Pye Group in Australi manufacturing a new electricity distrib system for power and lighting requirem Known as "Electrorail," it consists continuous lightweight tubular housing closing copper conductors, into which off plugs can be inserted at any poin wide range of take-off boxes incorpor circuit breakers or fuses is available use with the system. The manufact say one of the main advantages of system is its flexibility, which allows location of power take-off points t carried out within a few seconds.

A leaflet describing the system is able from the maker's offices at Dumbarton Street, North Sydney, N.S.W.

TECNICO ELECTRONICS PTY. are Australian agents for a new B integrator developed in U.S.A. by Princ Applied Research Corporation intended the recovery of either complete repe waveforms or incremental portions th from noise.

The integrator is a gated signal aver device. It may be used in such w varied applications as pulsed nuclear netic resonance, laser excitation decay biological evoked response experiments. gate-timing circuits have four oper modes: external trigger; external gate; current with time base triggered auto cally and repetitively; and continuous gate on continuously.

Time base widths are 10 microsec to one second in 1, 2, 5 sequence. pulse width is continuously adjustable one microsecond to 0.11 second. Delay be manually adjusted from 0 per cen 100 per cent of the time base width. A matic scanning is achieved from 0 cent to that per cent of the time width selected by setting the manual d dial. Automatic delay scan periods ar 2, 5, 10, 20, 50 and 100 minutes.

Further information can be obtained f Tecnico Electronics Pty. Ltd., Carrin Road, Marrickville, N.S.W.

AMPEX CORPORATION, of Redw City, California, U.S.A., has introduce new broadcast-quality magnetic video for use with Ampex VR-660 Series VR-1500 Series helical scan videotape corders. Advantages claimed for the tape are superior dropout performa long-term still-frame capability and effic operation under high temperature humidity conditions. The improvements tape performance are said to be the re of a more unified binder formula develo specifically for tape used with Ampex corders.

The new tape, called 142 Series, is wide and supplied in various reel s allowing playing times from 32 minutes more than four hours. The standard reel plays for 64 minutes. Ampex are re sented in Australia by Ampex Austr Pty. Ltd., 26 Ridge Street, North Syd

FERRIS BROS. PTY. LTD. is marketing a portable record player auto changer, called the "Easybeat". M Designed for operation from 240V ma it will play standard 78 rpm or LP m or stereo discs. The unit is self-contai for portable operation, with inbuilt speak (8 x 4in), but has provision for exte speaker. Ferris say the all-silicon transi amplifier will give 3W undistorted po output and when used with matching lo speaker enclosures, supplied as optic extras , frequency response is 40 15,000Hz.

The unit measures 15¼ x 14½ x 6 and weighs 16lb 1oz. Retail price is $84 The matching loudspeaker enclosure, c taining two speakers and crossover netw retails at $39.90.

JOHN DAVIS AND SON (DER LTD., All Saints Works, Derby, Engla has developed a voltmeter specifically testing intrinsically safe circuits in haza ous atmospheres. The meter is classified Intrinsically Safe for Class 1m, 2a, 2d and 2e gases.

Of totally enclosed construction, meter is of the moving coil type and scaled from 0 to 30 volts. The pointer fully damped and readings can be ta with the meter held at any angle.

Program Source

(Continued from Page 77)

dary leads pass, should have rubber ommets, with the mains lead held by strap bolted to the chassis to prevent ain from being exerted on the tag-ip connections.

Because of the higher selectivity of is tuner, and the conditions under iich it is likely to operate, there may t be a very strong case for a whistle ter stage. However, we have left om for it, should it be required.

In the rear view photograph, to the ft of the audio output lead, are two les; the one on the left is for mount-g the whistle filter coil, while the her is for the 100K tab pot. The 9-n miniature socket for the 12AU7 ounts in the area between the 0.1uF pacitor on the 8-lug IF tagstrip and e 2-lug audio output tagstrip. To commodate the additional compon-ts, the latter tagstrip needs to be re-aced by an 8-lug unit.

Alignment procedure for the tuner is ormal, although one or two points are orthy of mention.

The IF alignment should be carried it with the selectivity switch in the ormal" position, with all four wind-gs functioning. Align the IF trans-rmers to 455KHz, with the slugs in the outermost positions.

If the IF channel should show signs of instability, check first to see that the various plate and grids leads are short and direct, that the spigots of all valve sockets are earthed and that all bypass capacitors are as specified. If the instability has no such obvious cause, add a neutralising capacitor, as shown in our circuit, re-peak the IF windings and note whether the channel is now stable. The 8.2pF capacitor specified is fairly typical, but the optimum value will vary in each case. If the capacitor is made larger in value than strictly necessary, it will reduce both gain and selectivity.

When aligning the broadcast band, we found some difficulty in achieving proper coverage at the low frequency end with the usual 425pF padder capacitor. We corrected this by wiring a 22pF in parallel with the 425pF unit and then subsequently ascertained from the coil manufacturers that 450pF was a value that they themselves had used on occasions. Dial tracking with this value is quite satisfactory.

The short-wave coils are intended to cover the range 5.95 to 17.9MHz and they should work out quite close to this with the cores well in, the trimmers well out. Unfortunately, no pre-calibrated dial scale is available at the time of writing and constructors may have to devise something to suit themselves, at least for the time being. ▬

BASIC OSCILLATOR — Continued

not to be confused by the second harmonic of the oscillator. Thus with the receiver tuned to a station on the high end of the band (say 1400KHz), it is quite possible to be misled by tuning the oscillator to half the frequency (i.e., 700KHz).

That concludes the description of the "Basic Test Oscillator," which should give our younger readers and other experimenters an intriguing and educational start into the realm of test instruments.

But having constructed the unit, you'll want to know how to use it in general testing and receiver alignment. For this we would refer you to chapters 14, 15, and 18 of our "Basic Radio Course," of September and October 1964 and February, 1965. As mentioned earlier, those who cannot refer to the relevant back issues needn't worry — the complete course will shortly be available as a book. ▬

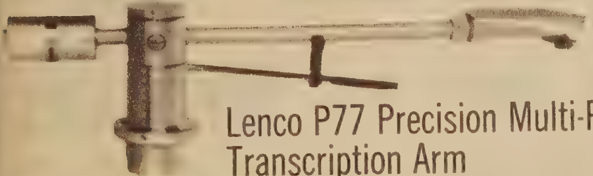
Stereo equipment?
Only Goldring have it this good.

G.99 Transcription Unit

For enthusiasts requiring a unit of high transcription quality, but wishing to use a transcription arm of their own choice.
Features an 8 lb. non-magnetic, diecast, dynamically balanced turntable—fully variable speeds—a vertical drive system and a neon-lit stroboscope.
Wow and flutter is less than 0.2%—rumble and hum are negligible. Turntable speed variation is less than 1% for 13% mains voltage change.

Lenco GL.70 Precision Transcription Unit

Precision engineered GL.70, features an 8 lb. non-ferrous, non-magnetic, diecast, dynamically balanced turntable—fully variable speeds—built in "Micro-lift"—pick-up weight adjustment—detachable head shell—and a vertical drive system. Wow and flutter is less than 0.2%. Optionally fitted with the latest Pickering V15/AM1 low mass, high compliance magnetic cartridge. Compliance = 16 x 10^{6} centimetres per dyne; Channel Separation = 35 db at 1 KC.



Lenco P77 Precision Multi-Plane Transcription Arm

TECHNICAL SPECIFICATION
Overall length of pick-up arm 330 m.m. (13"). . Diameter of pedestal 34 m.m. (1.34"). Overall height with screening can 150 m.m. (5.9"). Maximum height adjustment 30 m.m. (1.18"). Tracking length (turntable spindle to pedestal spindle) 210 m.m. (8.27"). Stylus overhang 17.1 m.m. (0.67"). Maximum adjustment of Stylus position 10 m.m. (0.39"). Offset angle 23° 12'. Tracking error ± 0.8°. Length of cable 1.10 m. (43"). Capacity (plug-in shell to amplifier input) 160 pF. Moment of inertia (without cartridge) 148 grs.^{2}/m.m. Low frequency resonance with cartridge of compliance 5 x 10^{-6} cms./dyne = 10 c/s.

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The resistors are mainly I.R.C. and Morganite in values from 200 ohm. to 5 meg. in ½, 1 and 2 watt ratings and include some wire wound resistors. List price, $9.00 per 100. **Our price, $2.00 per 100.** Post and packing 25c extra.

The condensers are in most popular makes and include mica, ceramic, paper and electrolytic in standard values. List price, $11 per 100. **Our price, $2.06 per 100.** Post and packing, 35c extra.

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These shoulder megaphones manufactured by National Radio Japan have an output of 4 watts, and are supplied complete with inbuilt horn type speaker, batteries and microphone. List price $78.

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Other types also available.

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Extends to 36in each section can be used singly for car or portable **$1.50**

Post 20c.

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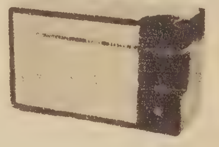
These 4" speakers are mounted in polished cabinets suitable for use as intercom. units or extension speakers.

LIST PRICE .. .. $12.

SPECIAL PURCHASE ENABLES US TO SELL THESE UNITS AT $4. Post and packing, N.S.W., 68c. Interstate, 98c.



NEW GARRARD RECORD CHANGERS

These New English Garrard Changers with High Fidelity Crystal Pick-ups and Sapphire Styli have just been superseded. We are selling some at LESS THAN HALF PRICE. Available in STEREO at $25.50. POST AND PACKING EXTRA, N.S.W., $1.50; QLD., VIC., TAS., $2.25; W.A., S.A., $1.30.

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240V A.C. operated, 6 band 120KC to 390 Mes

Provision for crystal.

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The ideal deck for the home constructor, as amplifier and all controls can be mounted on deck.

● 3-speed 1⅞, 3¾, 7½. ● Pause control. ● Takes 7in. spools. ● Simplified controls, 4 Track, $48; 2 Track, $44. OSC Coils, $1.50

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23 RANGES. 240V. A.C. powered.

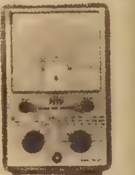
D.C.V. 1.5, 15, 50, 150, 500, 1,500

A.C.V. 1.5, 15, 50, 150, 500, 1,500.

D.B. —10db to +60db.

Resistance. 1 ohm to 1,000 megohm.

$42.50 **POST $1.00**



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25 WATT .. $53.75, £26/17/6
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Post Extra on 15 Watt N.S.W., 10/; Interstate, 15/. 25 Watt by Rail or Air. Too Heavy, for Post.

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The 25 Watt Amplifier uses 5 valves plus 2 rectifiers including two EF86 low noise valves as microphone preamplifier and two EL34 valves Ferguson push-pull output.

All amplifiers are fitted with Ferguson output transformers with voice coil tappings of 2 to 15 ohms.

The 25 watt amplifier can be supplied with line output transformer tapped from 100 to 600 ohms if required at 20/extra.

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The 15 watt is as above but using two 6BQ5 valves in push-pull output.

12in speaker for above (10 watt)	**$6.75**	.. **67/6**
Crystal Microphones for amplifier	**$4.75**	.. **47/6**

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EW AMERICAN TV POWER BOOSTER UNIT AT LESS THAN HALF PRICE

$9.75 (£4/17/6) POST FREE

(EX LIQUIDATION STOCK H. G. PALMER)

These TV POW-R boosters can be used in two ways. Firstly as a "straight-thru" circuit giving extra boost to the TV signal for improved performance on one receiver.

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Full instructions supplied with each unit. 240 volt A.C. operation.

Complete KIT for TRANSISTOR 6 PORTABLE $21.95

The complete kit of parts for the transistor six includes six transistors, printed ircuit board, coil kit, 4in speaker, Ferguson driver and output transformers, eavy duty battery and all necessary parts to complete the set with full intructions. **Set is housed in attractive plastic case as illustrated.**

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TYPE	EQUIVALENT		
XA101	OC45	R.F. Transistor	55c
XA102	OC44	Osc. Transistor	75c ea.
XB103	OC75	AUDIO general purpose	75c

Ducon type SFT 123 equiv, OC74 .. .. .. 75c ea.
Available in matched pairs at .. .. $1.50 pair
AUDIO OUTPUT

Post and packing on transistors 15c any quantity.

A.W.A. 23" E.H.T. transformers and 23" 110 deg. deflection yokes. New manufacturers stock E.H.T. units $5.00. Deflection yokes $5.00. Post free

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1D8GT	95c	5V4G	$1.00	6K8G	68c	6U7G	45c	12SK7	50c
1K5G	40c	6B8	$1.00	6Q7G equiv. 6B6G	$1.00	6X5GT	75c	12SK8	50c
1K7G	49c	6C8G	50c	6SA7GT	95c	7C7	35c	12SH7	50c
1M5G	40c	6F6	$1.00	6SH7	55c	12AU7	$1.00	866	1.50
1P5G	25c	6H6	35c	6SJ7	95s	12AT7	$1.00	954	25c
1Q5G	25c							955	25c
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EF50	45c							EL33	$1.00

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AT LESS THAN HALF PRICE

PHILIPS 4-SPEED
6V BATTERY PLAYER
MONO $9.75
STEREO $11.75

Post and Packing, N.S.W., 75c.
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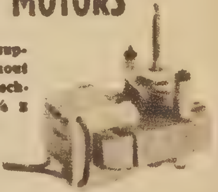
NEW 240V. ELECTRIC MOTORS

3300 R.P.M. can be supplied with or without 4-speed reduction mechanism. Size 3¼" x 2¾ x 3¼, including spindle.

$2.75



NEW PORTABLE RECORD PLAYER CASES TO SUIT THE ABOVE TURNTABLE

Attractive two-tone cabinet with plastic trim.
Supplied with 5in x 7in speaker in felt-lined enclosure
Space for amplifier and batteries or power supply.

$11.50

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NEW MULTIMETER—$5.25

POST EXTRA
METER 0-1MA 1,000 OHMS PER VOLT
A.C. RANGES D.C. RANGES CURRENT
SUPPLIED COMPLETE WITH TEST LEAD
RANGE 0-100,000 OHMS

0—10v	0—100v	0—500v	0—500MA
0—50v	0—10v	0—1000v	
0—250v	0—50v	0—1MA	
0—500v	0—250v	0—100MA	

EXTENSION SPEAKERS

New 9 x 6 speakers in case.
Post: Interstate, 55c; N.S.W. 40c.

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0mA prim.: 240v with 230v tapping Sec. 85 x 285 with 6.3v filament winding. 0mA, $2.50. Plus Postage: N.S.W., 35c; nterstate, 52c.

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Before buying see our range of T.M.K. test instruments. As advertised in April issue of Electronics Australia.

NEW MIDGET POWER TRANS.

40mA prim., 240v. Sec 225 x 225 with 6.3v. Fil. Winding.

$2.75 Postage: N.S.W., 25c; Interstate 45c.

30mA 240v Prim. 150 x 150v. Sec. with 6.3v Fil. Winding.

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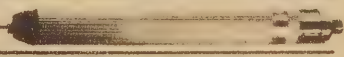
TRANSISTORISED SIGNAL INJECTOR, $5.50

A MUST FOR QUICK TROUBLE SHOOTING
Using TWO Transistors, complete with instruction sheet and battery. Post free.



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A. C. E.

AMPLIFICATION

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10-Watt, Two Channel, with Twin Cone Speaker, $51.50 (£25/15/).

14-Watt, 4 Inputs, Bass and Treble Boost. 2 Twin Cone Speakers, $59.50 (£29/15/).

17-Watt. Four-Channel. Bass and Treble Boost. Two Twin Cone Speakers, $73.75 (£36/17/6).

35 WATT

4-Channel, Bass and Treble Boost. 4 Twin Cone Speakers, $105 (£52/10/).

Vibrato with foot control and 2 pre-set controls for frequency and intensity. $10.56 (£5/5/) extra on above models.

14 plus 14 WATT

With Reverberation. May be used as 28 Watt or as 14 Watt plus 14 Watt Reverb. Two 9 x 6 Woofer Speakers. Two 9 x 6 Twin-Cone Speakers. 4 Channels. Bass and Treble Boost. Foot Vibrato Control included.

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SLAP BASS OR BASS GUITAR 40 WATT AMPLIFIER

4 Input Channels. Bass and Treble Boost. Two 12in Radial Beam Speakers. Perfect reproduction on 20 cycles.

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PIGGY BACK GUITAR AMPLIFIER

30 Watt	$79.75
45 Watt	$99.75
60 Watt	$119.75

4 Inputs. Bass and Treble Boost. Vibrato if required. $10.50 extra.

TAPE ECHO UNIT

Suits any Guitar amp. without any alteration.

JUST PLUG IN

$139.50

REVERBERATION PRE AMPLIFIER

Suits any Guitar amp.
No changes necessary.
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Completely transistorised.

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FUZZ-BOX

Incorporating simple reverb. Easily adapted to any Guitar or P.A. amp. Complete with foot control.

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PLAYMASTER 4 STEREO AMPLIFIERS

Push-Pull. 8 Watt per Channel. Bass and Treble boost and Cut.

Wired and Tested.

£38/10/- $77.00

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240 V. operation. No change. To set. Simple connection. Extra gain on all channels.

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Post 50c.

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	£	s	d
3in. Mylar LP 300ft. ..		10	6
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5in. Mylar DP 1200ft. ..	1	5	0
5¾in. Mylar LP 1200ft...	1	5	0
5¾in Mylar DP 1800ft	1	17	6
7in. P.V.C. 1200ft. .. .	1	5	0
7in. Mylar LP 1800ft. ..	1	17	6
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Post 2/6 per Spool.

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8 WATT

8in. Units in Waterproof Projection Horns.
15 Ohm Voice Coils.

$13.50 £6/15/-

In Double Ended Flares, Duolateral Coverage.

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Line Output Transformers to suit, $1.75 (17/6) extra.

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American Rating. 30 Watts, Voice Coil 16 ohm.

$21.50 £10/15/-

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REFLEX HORNS TO SUIT.

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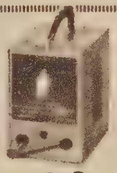
PHONE XW5956 FOR APPOINTMENT TO TEST STEREO GUITAR AMPLIFIERS AND TELEVISION.



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240 Volt A.C. Operation

3 Rate 6V, 12V TRICKLE CHARGE

Trickle Charge Position suits all Batteries. 2V to 12V at rate of 200 to 500 M.A.

STANDARD

2 amp. 6V, 12V, TRC ..	$11.50
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4 amp. 6V, 12V, TRC .	$15.25
5 amp. 6V, 12V	$15.95

Post., N.S.W. 75c, Interstate $1.25

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1½ amp., 6V-12V	$9.75
3 amp.	$16.75
4 amp.	$19.75
6 amp.	$21.75
10 amp.	$27.75

Rail or Air Freight on.

MULLARD MAGNAVOX

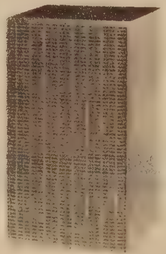
BOOKSHELF ENCLOSURE

Maple, Teak or Walnut

Complete $26.00

Post: N.S.W. 5/-. Interstate 10/-.

Full range of Playmaster Bookshelf units.
For 6", 8" or 12" Speakers.



Reverberation Unit
for Stereo Guitar & Organ Amplifiers
ACE RADIO MARRICKVILLE
Input
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REVERBERATION UNITS

Latest design to suit orga stereo, guitar, any hi-fi equ-ment.

£2/17/6 $5.75

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ELEGA REVERB. SPEAKERS

Automatic addition of verberation to any exist amplifier.
Handles 12 watts.

£12/15/- $25.50

CO-AXIAL SPEAKE

C.S-30. 12"

V.C. 16 ohm. Cross over 3, cycle. Frequency range 30 20,000 cycles. Rated 20 wat

£13/19/6 $27.95

C.S-20. 8"

V.C. 16 ohm. Cross over 3,000 cycle. Frequency Range 40 to 20,000 cycles Rated 8 watts.

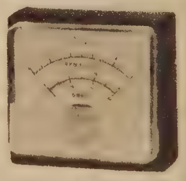
£7/19/6 $15.

HORN TWEETER

CT-3

2,000-20,000 Response.
20 Watts Power.
Sensitivity 110 dbw.
Weight 1⅜lb.

£4/9/6 $8.95



MULLARD-A.C.E. TACHOMETER

Wired and tested.

$20.75 £10/7/6

"Electronics Australia," Ju August issue. State max. revs., vo age, polarity cylinders.

METER ONLY

$6.75 £3/7/6

INCLUDING DWELL. ANGLE FACILITY

$23.25 £11/12/6

Post., N.S.W., 50c; Interstate, 75

AMATEUR BAND NEWS AND NOTES

I.A.R.U. Region III Conference

Ways and means to achieve closer co-ordination of aims and the interchange of ideas between I.A.R.U. societies in Region III is receiving special attention by the Federal Executive of the W.I.A.

By Pierce Healy, VK2APQ*

'he necessity for closer liaison between member societies of the International ateur Radio Union has been the subject much speculation and discussion during ent years. Nearer home, the need for er co-operation between Region III soci- s, and the formation of a body to resent Region III societies on an interna- ial level, has been discussed at Federal iventions of the Wireless Institue of stralia.

n 1959 the W.I.A. was the only society Region III that had an observer, indepen- it of any other service, attached to an cial delegation at Geneva. The same lied in 1963 when the W.I.A. was repre- ted at the I.T.U. Space Services Con- ence. Unfortunately there was little sup- t or interest on the part of other Region societies who were approached on those asions.

'o maintain the status of the amateur vice and to conserve frequency allocations t exist today, it has become obvious to se interested in amateur radio, that it is ential for the amateurs' case to be pre- ted in the best possible way at future '.U. discussions, especially when amateur quency allocations are under review.

)istance, and the cost of holding a con- ence of societies in Region III, have been iting factors. The problem of financing h a conference is a subject that is being roughly investigated at the present time.

'he one major stumbling block seems to the apparent total apathy on the part of very large percentage of amateurs to a tter so vital to the continued recognition the amateur service at international level.

No amount of work on the part of officers the various societies can bear fruit unless support of all amateurs is forthcoming.

Fortunately the same difficulties do not ist in Region I, where it has been the actice to hold regular conferences, when resentatives from European countries and rth America can meet under much more nomical conditions in relation to both ie and finance.

I.A.R.U. activities show an increasing areness of the pressures being brought bear on the amateur service to continue prove its worth, and present cogent rea- is why the service should be considered in y deliberations on radio frequency alloca- ns at I.T.U. conferences. These thoughts ve also been expressed by members of I.A. and N.Z.A.R.T., the New Zealand nateur society, who, during trips overseas, ve been able to discuss first hand how rrent trends may affect the future of iateur radio.

In a report on his trip to England and Switzerland, T. R. Clarkson, ZL2AZ, who on behalf of the N.Z.A.R.T., discussed various aspects of amateur radio with officers of the Radio Society of Great Britain, the International Amateur Radio Club and with Messrs Hoover and Huntoon, president and secretary of the International Amateur Radio Union, made these observations:

"The welfare of amateur radio is a subject of vast magnitude and great complexity with extensive background influences.

"Everyone agrees that amateur radio's future is uncertain. The conditions of operation or indeed the right to operate at all rest directly on the decisions of the conferences of the I.T.U. The methods the I.T.U. uses to conduct its business dictate the means that must be employed to uphold the interests of amateur radio. It is vital to ensure that at future radio conferences the voting participants are properly briefed and instructed in matters affecting amateur operation.

"A concerted approach by amateurs throughout the world is needed in order:

1. To develop and advocate desirable policies.
2. To get national delegations to I.T.U. conferences who are favourable to amateur interests and are properly briefed for all contingencies.

"In some countries amateur radio is organised, and recognised by the community, and enjoys the confidence of the government. In some less developed countries the only amateur activity is by resident foreigners, so the government cannot be expected to have special compassion for their interests.

"The value of amateur radio as a national asset needs to be appreciated by all governments so they will do the right thing at I.T.U. conferences. Amateur radio is a defined service of radio communication. Governments should be influenced to recognise this by having their representatives help to prepare national policies prior to I.T.U. conferences and to ensure that delegations include one or more persons to concentrate on amateur matters, on an official basis.

"The I.A.R.U. is recognised officially by the I.T.U. as an international agency. This means, it can attend administrative I.T.U. meetings and, if desired, make its voice heard, but it does not have a vote. Recognition is important as it enables the Union to fraternise with delegates and help keep amateur radio identified at conferences.

"If exploited vigorously such activity could exercise a very strong influence. It is visualised that at I.T.U. conferences the I.A.R.U. would have a kind of secretariat which would arrange meetings and consultations among amateur-minded members of delegations and others who might be sympathetic, and meet the changing position of proposals coming up at meetings.

"References to world organisation would be incomplete without mentioning finance. Improvements along the lines of an international secretariat for the I.A.R.U. would mean contributions from member societies. This needs to be approached realistically. A small but definite part of the subscription needs to be earmarked to provide such contribution. Other expenditure in international matters such as attending conferences also has to be provided for in advance."

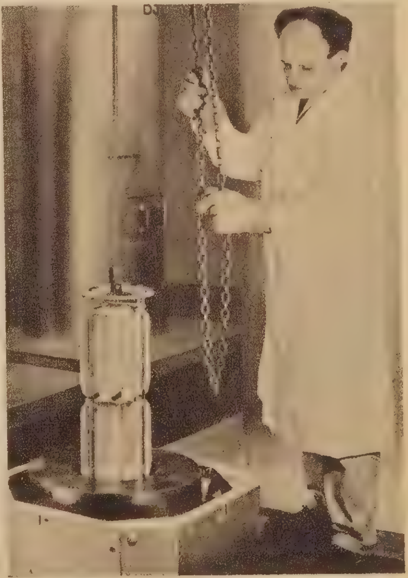
Other comments in the report dealt with comparisons between areas and conditions within the three regions and expressed the thought that a conference of all I.A.R.U. member societies should be considered. It also praised the work done by the I.A.R.C. but pointed out that it could not, by virtue of the fact that its officers were paid servants of the I.T.U., assume the role of representing the amateur service at international forums.

The report concluded with an expression of the opinion that the most important matter for the future welfare of amateur radio is to get the I.A.R.U. organised and working on a proper international basis and that the N.Z.A.R.T. declare a policy of supporting any move in that direction.

At the time of writing, a well-known Victorian amateur and former Federal Councillor for the Victorian Division, Allan Elliott, VK3AL, is visiting the Far East. Allan expected to be able to meet members and officials of many of the Region III societies during his trip. Allan was authorised by Federal Executive to ascertain the thoughts of these societies in relation to a Region III conference.

To those who have gained many pleasures from amateur radio over many years, the need for unity of action should be appreciated, irrespective of their personal views on membership of their local amateur society.

'ews and notes of Divisional and Club tivities submitted for inclusion in ese columns should be forwarded rect to Pierce Healy, 69 Taylor St., Bankstown, N.S.W.



Synthetic quartz is now widely used in the place of natural quartz in crystal oscillators. Here, newly formed synthetic quartz is raised from a thick-walled steel cylinder where it has been growing for 21 days under conditions of high pressure and temperature in the Standard Telephones and Cables Ltd. factory at Harlow, Essex, England.

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(i) have completed the departmental Radio Technician-in-Training course; **or**
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(iii) possess a Broadcast Operator's Certificate of Proficiency and be currently employed at a radio transmitting or receiving station; **or**
(iv) possess recognised first-class tradesman qualifications in the Electrical Fitter and Mechanic, the Fitter or Tradesman (Radio) areas.

Salary ranges from $2,397 to $3,067 per annum and commencing rates may be fixed within limits of $2,567 — $2,767 (Groups 1 and 2) or $2,397—$2,567 (Groups 3 and 4) depending on experience. Salary progression beyond $2,767 or as applicable $2,567 subject to advancement examination (s) details of which will be supplied on application.

Ring Miss S. Garnham telephone 32-2451, Ext. 228 or write to:—

Regional Director,
DEPARTMENT OF CIVIL AVIATION,
Box 1733 P, G.P.O.,
MELBOURNE, C.1.

W.I.A. Activitie

With the advent of spring and wa
weather, comes the period for divis
and regional conventions and general
day activities. These events allow exch
of points of view on various topics-
latest piece of gear constructed, the
DX worked, Institute matters or pers
matters with old friends.

All divisional organisers extend a h
invitation to all amateurs to attend
get-togethers and especially welcome i
state and overseas visitors. Be sure t
along, it is the opportunity to meet
friends and make new ones.

JAMBOREE-ON-THE-AIR

The very popular Scout Jamboree-on
Air, held in conjunction with ama
operators throughout the world, will
held during the weekend October 22-23.
Wireless Institute of Australia acti
supports this event and all amateurs
invited to participate. A full resume of
aims and general information on the e
will be given in the October issue of t
notes.

NEW SOUTH WALES

Two conventions are set down for
first weekend in October. This being
Six Hour Day holiday weekend in
South Wales, it allows those wishing
attend to travel greater distances.

The Annual Dinner and Field of
Hunter Branch will be held at Newca
and the South West Zone Convention
be held at Wagga.

SOUTH-WEST ZONE CONVENTIO

Location: Wagga Wagga. Picnic grou
at Lake Albert.

Date: October 1st, 2nd and 4th, 19

Registration fee: $1.50 per adult m
ladies and children free.

Official Dinner: Saturday night 1st O
ber, Lake Albert Hall. Dinner cha
adults $1.75. Children 75c.

Motel Accommodation: Limited, beca
of heavy demand on all accommodat
due to the fact that the Wagga Sh
continues into this weekend. Motel ra
$4.25 bed and breakfast. Reservations m
be made early. Bookings to be made thro
Sid Ward, VK2SW, 33 White Ave
Kooringal, Wagga. A deposit of $2 e
person each night accommodation is
quired.

Camping Facilities: Good clean camp
site available. Those wishing to use th
facilities should also contact Sid Wa
VK2SW, early, in order to avoid dis-
pointment.

Mid-day meal, Sunday: Meals will
available at the picnic grounds at La
Albert. It would be appreciated if th
wishing to be catered for at this meal a
or the Official Dinner on Saturday ni
would make reservations prior to the act
Convention weekend. This will greatly as
the caterers. Free ice cream and soft dri
for the children. Hot water available. D
posals equipment, Displays, Lucky tick

It is anticipated that 7MHz and 144M
transmitters operating under the Wag
Radio Club call sign VK2WG, will be
the air from the Convention site fr
10 a.m. to 5 p.m. on Saturday, 1st Octob

Contests: An additional contest has be
introduced this year to cater for all 7M
mobile stations while en route to the C
vention, on Saturday, 1st October. T
contest will be in conjunction with
Convention base station which will be
the air from 10 a.m. to 5 p.m.

Mobile operators may compete for ma
mum points, gained by working the b
station VK2WG, once for each 50 mi
travelled, commencing from their fr
gate.

For example: A mobile leaving Sydn
bound for the South West Zone conve
tion may be able to contact VK2WG as
leaves, and receives a contest number

t. When this same mobile has travelled ther 50 miles he may contact VK2WG another point. This scoring continues into the Wagga area. The last scoring may be made once the city limits entered. This same mobile travelling Sydney would thus be able to score aximum of seven points, including the received in the city limits.

is scoring variation has been duced mainly to add interest for those ileers who will be travelling long dis- es to attend this convention. In fairness hose who may be travelling through lightly populated with amateurs, the contacts that will qualify for scoring be those made with the official con- ion station.

the case of a dead heat the mobile on using the lowest power will be de- d the winner. However, it is thought the consistently varying skip distances 7MHz will ensure that it will be very cult to obtain perfect scores over the er distances.

rther particulars regarding this new t will be included in divisional broad- s.

s usual a full program of contests has arranged for Sunday. These will in- e an all-band scramble to coincide with Hunter Branch event; two-meter hidden smitter hunts, and transmitter hunts for estrians and blindfold contestants.

londay, October 3rd, activities will be ndent on the number of visitors re- ning at Wagga following the conclusion he convention on Sunday.

cordial invitation is extended to all teurs to attend this year's South West e Convention, particularly to those in oria. The weather should be perfect, with the added interest of the Wagga w being in full swing during the Satur- it should prove to be a most enjoyable kend for those amateurs and their ilies who spend their holiday weekend members of the Zone at Wagga.

ll inquiries should be directed to Sid d, VK2SW, 33 White Avenue, Koorin- Wagga.

HUNTER BRANCH

near record number attended the July ting of the Hunter Branch, 45 members visitors being present. Consistent with nch policy providing the best in lectures members, there were three speakers, chose widely differing subjects of inte- to amateurs.

n Fyfe, VK2ZIF, who had previously ken on converter circuits, outlined his urite design for a two-metre unit. This t uses two 6CW4s in grounded grid figuration and gives excellent results at 's difficult location at Hamilton. He gave ils of the layout of this project and eral members are building replicas of the t.

he second lecturer was Max McLachlan, spoke at length on soundproofing and conditioning the shack. Max has had a d deal of experience in this work and already completed a project on the s described by him. The measures to be ertaken were described in a four page ler given to each member of the ience.

ill Hall, VK2XT, a well known DX rator, was the third speaker. He des- ed the helical whip aerials he uses for bile operation. Bill has used this type of ial for some time and has put a great l of thought and effort into the design a radiator with maximum efficiency when d to a car. He gave full details on struction and alignment of that type of enna in a sheet of instructions handed each member present.

t is interesting to note that Bill has had at success with the design described. He worked the DXCC mobile since Feb- ry this year. Many of the stations con- ed reported that his mobile signal is as strong as that from his commercial e element beam used at his home station.

ctivities on the 146MHz net frequency d by the WICEN group received a st during July with the addition of two more stations. Des Mills, VK2ZDN of Cardiff, well known VHF operator is now active on this frequency, as is Jan Oosterveen, VK2BJO of Awaba. Both use converted MR3 transceivers.

HUNTER BRANCH CONVENTION

A meeting at the Technical College Tighe's Hill on Friday evening, 30th September, will open the proceedings for the Convention weekend. The evening will be devoted to a "Constructional Competition" when members are invited to describe some constructional project they have undertaken and which has not been previously shown at a Hunter Branch meeting.

On Saturday, 1st October, the Annual Hunter Branch Dinner will be held at the Charlestown Community Hall, commencing at 7.30 pm.

On Sunday, 2nd October, the popular Hunter Branch Field Day has been organised, to take place at Bolton Point Park. Bolton Point is 1½ miles east of the main Newcastle-Morisset road, the turn off being at Fennells Bay, 16 miles south of Newcastle.

The programs for the Field Day will comprise the usual Hidden Transmitter Hunts on 7MHz and 144 MHz and an All-Band Scramble. There will also be events for pedestrians.

Bolton Point Park is well equipped for a field day with a large new hall and spacious grounds sloping down to the water's edge. There is an excellent swimming pool adjacent with new brick dressing rooms. In all, it is an ideal place for a picnic.

At the Field Day there will be a canteen in operation, serving hot food and drinks as well as soft drinks and ice cream.

All the final details of the convention weekend will be given over the Divisional broadcast from VK2WI and also from the Branch station VK2AWX. These broadcasts are at 11 am on Sundays and at 7 pm on Mondays, on the frequency of 3595KHz.

CENTRAL COAST BRANCH

Several visitors and two new members were welcomed at the July meeting of the Central Coast Branch, held at the School of Arts, Gosford. The new members are Fred Orvad, VK2AHX and Ross VK2ZRQ. Another new call sign in the area is VK2RC, John Campbell, of Wyong. John has been confined to his home for some years, following an accident and will no doubt find amateur radio a most enjoyable hobby.

The lecture for the evening, given by Ian Fyfe, VK2ZIF, of Newcastle, was about transistors. Ian drew on his wealth of knowledge to pass on many useful hints on working with transistors. The tools recommended ranged from an inexpensive surgical instrument to spring-loaded ladies' hair clips.

The Branch President, Lindsay Douglas,

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S.E.W. TRANSISTOR MODULES.
Model 10/20—The Smallest Hi-Fi quality 10 Watt Amplifier in Australia.
AVAILABLE AS KIT
with full instructions or **PRE-BUILT.**
Actual size: 1½" x 1½" x 1½".
Response: 20 c/s—20 K/cs. Output: 10 Watts into 1.5 ohm load. Operates from 4.5 to 15V. PRICE: £7/10/ ($15). Plus Tax. Power Supply £6/12/6 (13.25) Plus Tax.
Also available, Model 13, 10 watt, 15 ohm, Model 25/50 Silicon 25 Watt, 15 ohm output.
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A full range of Hi-Fi and P.A. Kits available for all purposes from 3 Watts-100 Watts.
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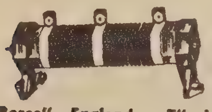
The resistors (rheostats) listed below can be used for many purposes. Dimming lights, all voltages 6, 12, 24, 32, 110, 240 volts. Controlling speeds of electric motors, dropping voltage, e.g. 240 to 110/115 volts A.C. or D.C. and raising voltage, etc.

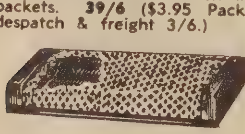
VARIABLE RESISTORS (Rheostat) 35/- ($3.50) Freight, etc., 3/6

Made by "Zenith and Birch", England. 7" long with mounting stand at each end and slider control. Extremely conservatively govt. rated at 12 amps. (400 watts) for any voltage tested to 18 amps. (550 watts). Use for any voltages 6-240v. A.C. or D.C. to 550 watts. (Will dim 5 x 100 watt bulbs.) For dimming lights; controlling amp. output in generators to 100 amps 32 volts; controlling speeds of electric motors, etc. Govt. cost $16 ea. Must be enclosed if used for 240 volts.

Same as above. Rated though for 4 amps tested to 6 amps (200 watts). Resistance 14 ohms **32/6** ($3.25 Pack, despatch & freight 3/6.)

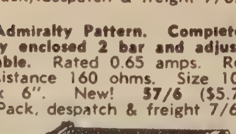


"Berco" England. 7" long, rated 16 amps on 32 v. Tested to 24 amps (750 watts) for any voltage to 240v. A.C. or D.C. Mint new condition in packets. **39/6** ($3.95 Pack, despatch & freight 3/6.)



Admiralty Pattern. Completely enclosed, 4 bar adjustable, also with tappings. Rated 1 amp (tested 2 amps). Resistance 150 ohms. Size 13" x 6½". New! **75/-** ($7.50 Pack, despatch & freight 7/6.)

Admiralty Pattern. Completely enclosed 2 bar and adjustable. Rated 0.65 amps. Resistance 160 ohms. Size 10" x 6". New! **37/6** ($5.75 Pack, despatch & freight 7/6.)



4 bar Admiralty pattern. Rated 5 amps tested to 8 amps (250 watts). Resistance 3 or 4 ohms. Size 9" x 7". Brand new! **49/6** Pack, despatch & freight 7/6.)

4 bar Admiralty pattern. Rated 21 amps, tested to 30 amps (1000 watts). Resistance 0.3 ohms. Size 9" x 7". **52/6** ($5.25 Pack, despatch & freight 7/6.)

Admiralty pattern. Completely enclosed and adjustable. Size 9" x 3" single bar. Rated 1.5 amps. Tested to 2 amps (65 watts). Resistance 20 ohms. **New! 37/6** ($3.75 Pack, despatch & freight 5/-.)

4 bar adjustable resistors (Admiralty pattern). Rated 7 amps tested to 10 amps (300 watts), resistance 3 ohms. For any voltage to 240v. A.C. or D.C. Size 7" x 9". Brand new! **47/6** ($4.75 Pack, despatch & freight 7/6.)

SEMI-CONDUCTOR MODULES

Encapsulated circuits

Solid state semi-conductor modules—fully transistorised and completely wired and tested circuits, that only require a 6 volt battery (or less) and connection to input and output to provide a compact, ready-made unit. Encapsulated types are shockproof and almost indestructible. Each is supplied complete with wiring instructions.

PUBLIC ADDRESS AMPLIFIERS

49/6 despatch & freight 2/6

Needs only crystal or dynamic microphone of either high or low impedance and any loudspeaker to complete, and power from a 6 volt battery to operate. Frequency response is designed to provide maximum intelligibility from speech. With a really large loudspeaker sound can be heard over 100 yards away. Fully encapsulated. Size only 1½ x 1⅛ x ¾".

BURGLAR ALARM SIREN MODULE

49/6 despatch & freight 2/6

Needs only 8-ohm loudspeaker, switch, and microswitch (or reed switch and magnet) to complete. Operation of micro or reed switch triggers upward screaming siren to give instant alarm. For home or motor car protection, fire alarms, warning signalling equipment, etc.

CLEARANCE! New English TRANSFORMERS

Top quality 1966 production selling at ££'s under usual price. All for continuous duty.

240 volt input, output 17v, 9v, 3v **at 4 amps. Only 52/6.** (Pack, despatch and freight 7/6) 4 amp. Rectifier (Converts A.C. to D.C.) to suit only 19/6 ($1.95). (These two items make a fine battery charger for charging 6v & 12v batteries at 4 amps.)

240 volt input, output 30 volts, 16 volts, 14 volts @ 5 amps.—79/6 ($7.95). (Pack, despatch and freight 10/-.) Silicone rectifiers 3 amps, 140 P.I.V. 12/6 (2 needed for A.C. to D.C. on this transformer.).

3½ AMP BATTERY CHARGER KITS

45/-

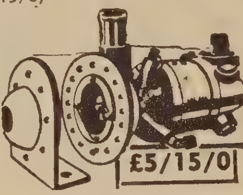
PACK, DESPATCH & FREIGHT, 4/-

Current production, English 240v. mains transformer English selenium rectifier, fuse holder with 4 amp. fuse, voltage selector panel, wiring diagram to make a splendid battery charger for 6, 12 volt batteries. Charges at 3 amps. All items are new. With smoothing condensor for model control power pack. $5.

PACK, DESPATCH & FREIGHT, 4/-

EXCLUSIVE RELEASE FAMOUS AMERICAN THOMPSON 1000 G.P.H. ELECTRIC PUMPS WITH MOTOR

Pump and motor only £5/15/-; Housing 35/-; Foot valve 15/6;



- **AIRCRAFT QUALITY** — neoprene seals throughout; fully ball-bearing non-corrosive housing and impeller.
- **CONTINUOUS DUTY MOTOR**—sealed, ball-bearing brush motor.
- **PUMPS ALL LIQUIDS** — water, kero, petrol, diesel fuel, etc. (1" outlet pipe for hose).
- **LASTING QUALITY**—sealed unit, corrosion and explosion proof.

Electric motor is for 24/32v. A.C./D.C. (perfect on 12 Volts) and draws only 5 amps. Will shift 1000 g.p.h. at 15 p.s.i., 800 g.p.h. at 6' head. On 24v. pump will lift 40 ft., less on 12v. If primed or with foot valve, will suck 20 ft. then lift 20 ft.; less on 12v. Pump can be bolted to side of tank or drum or used with impeller housing with angle base which has threaded inlet for 1" waterpipe.

240 to 30 volt 5 amp. transformer to operate pump on mains gives full output of pump, **79/6.** 240v. to 17v. transformer gives 400 g.p.h. on pump, **52/6.**

"NIFE" BATTERIES 12/6 ($1.25)

PACK DESPATCH & FREIGHT 2/-

Brand new! Nickel iron, spillproof, leak-proof cells—practically lasts for ever. 3 A.H. 1½ volts. Sizes 3½" x 2½" x 1". Couple together for any voltage—superb for spotlights, lamps, bells, flash equipment, etc.

AIRCRAFT LINEAR ACTUATORS, 95/-

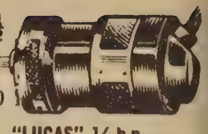
Pack, Despatch and Freight, 5/-

New, made by "Plessey" England. Have 24/32v. D.C. electric motor. 3 types available: 1½" stroke 250 lbs. push or pull 11" long. 2.3" stroke 100 lbs. push or pull 11" long. 3" stroke 100 lbs. push or pull 11" long. Ideal for remote turning off of irrigation taps, etc.

AIRCRAFT ROTARY ACTUATORS, 59/6

Pack, Despatch and Freight, 5/-

New! Made by "Teddington" England. Size 6" x 4". Many uses including remote turning of TV or radio antennae.



"LUCAS" ⅓ h.p. Electric Motors

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Brand new motors; a terrific purchase direct from British Govt. for 24/32v D.C. Made by "Lucas" "ROTAX" LONDON. Incorporates 3" dia. 12 blade fan; continuous duty 7,400 r.p.m. Motors have heavy duty ball bearings, 1" x ½" shaft for pulley. Clockwise rotation. Ideal for driving pumps, bench grinders, electric lawnmowers, etc. Works perfectly on 12v. Govt. cost $80.

4 Transistor 3 Watt Output AUDIO AMPLIFIERS

87/6 ($8.75)

Fresh 1966 current production brand new in cartons with instructions. Specially designed to provide a complete and reliable basic unit for portable gramophones, radios, intercoms, tape recorders, P.A. systems, etc. Latest printed circuit design suitable for 3 to 15 ohm speakers. For use with 9v. transistor radio battery. Frequency response 150-10,000 c-s. A pair are ideal for stereo. Size only 3" x 2"

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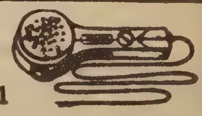
Originally made for hearing aids. Size 1" x ½". Extremely sensitive. Can also be used as miniature speaker. Use for tape recorders, guitars, etc. At a fraction of their original cost.



Canadian Hand Mikes

PACK, DESPATCH & FREIGHT, 2/-

This dynamic (magnetic) hand mike was used by Signal Corps. Very well made unit with press-to-talk switch. Sensitive insert will suit all P.A. systems, transmitters, etc. Brand new with 12' lead.

English 240 Volt ELECTRIC MOTORS

26/6 ($2.65)

FREIGHT FREE

These are finest quality English manufacture. Fully ball-bearing—3000 r.p.m.—shaft for drive. Are for cont. duty; beautifully made; brand new in carton. Original cost £4. 5" 3-bladed plastic extractor fan; ideal for removing kitchen, cooking fumes, etc., 7/11 (79c).

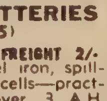
ELECTRICAL PRESSURE SWITCHES — NEW!

By K.D.G. instruments England. Brand new in cartons. Ex Nuclear power station. 240v. A.C.; range 0-15 p.s.i.; **5 amps type SP38,** 4" dia. **59/6** ($5.95). **0-16 p.s.i. by "B.T.H."** 6, 12, 24v. D.C. use 1 amp **New 5/-** (50c).

ENGLISH "HOOVER" ¼ H.P. ELECTRIC MOTORS

PACK, DESPATCH & FREIGHT 14/-

Big direct factory purchase. Tremendous savings on these brand new motors. 240v. single phase, ¼ h.p., 240v. A.C. mains; shaded pole; 1440 r.p.m., shaft both ends. Absolutely brand new in cartons. List price £13. Rush your order now



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2ON, gave a comprehensive description the 144MHz converter project which is ilable in kit set form from the W.I.A. osal store, Wireless Institute Centre, ws Nest.

he Branch meets on the third Friday in h month at the School of Arts, Gosford; ceedings commence at 8 p.m. Visitors intending members are always welcome.

WICEN EXERCISE

he New South Wales WICEN group has d a successful exercise near Berrima, th of Sydney. Taking part were 12 bile stations with a total of 17 operators.

he exercise was based on a simulated cking of a rocket nose cone and was also nded to be an exercise on communica- procedure, as set out in the recently ied brochure.

sidelight to the exercise was the strength the 146MHz signal from the FM trans- ter at VK2WI Dural, an airline distance over 60 miles. Communication was ablished with several of the mobile sta- ns as far south as Mittagong. VK2WI s strength eight at Berrima. The trans- ter at VK2WI runs 50 watts to a ground ne antenna.

WICEN MESSAGE PASSING PROCEDURE

The information contained in the pam- let on message passing procedures is sed on the Civil Defence publication ommunications Procedure (Radio Tele- one and Telephone)". It has been some- at simplified, having regard to the specific eds of the WICEN organisation.

In an introduction, it is pointed out that nessage passing procedure is an important ans to an end—the end being the carry- of information quickly and accurately. cannot be stressed too much, however, it the procedure is only the means to an d. An over-rigid, inflexible adherence to particular form of procedure, in certain cumstances, can have a reverse effect to effect intended.

It is also pointed out that good amateur erating practices, together with a funda- ntal net discipline, is very little different m the procedures outlined in the pam- let.

Under 24 sub-headings, details are given ating to definitions of phrases, words or breviations that would be encountered in ergency communication work. Also given examples of actual messages, the deter- ination of priorities and net control.

Copies of the pamphlet can be obtained those interested in WICEN activities, by iting to the Secretary, WICEN Group, 14 chison Street, Crows Nest: or by attend- the WICEN meetings, details of which e given over divisional broadcasts.

QUEENSLAND

At the July Council meeting of the ieensland Division, agreement was reached the status of the VHF group. In the past e Division has not had an official divi- nal VHF group. Following representa- on by VHF operators, it has now been solved that the VHF Group is an integral rt of the Queensland Division. Whenever acticable all matters pertaining to VHF d UHF activities will be referred to the HF Group representatives for comments d guidance before committing the Queens- nd Division on any policy matters.

SOUTH AUSTRALIA

Geoff Taylor, VK5TY, WICEN Co- dinator for the South Australian Division, ports that at a recent WICEN Group eeting the matter of message handling ocedure was thoroughly thrashed out. A ochure on the message handling procedure ill now be written and forwarded to all ICEN group members. It is also planned set up a complete functional structure ithin the group to control the various cets of the organisation.

It is also proposed to hold at least ne WICEN gathering each month. This ill take the form of either a formal ieeting or an organised field event.

VK-ZL OCEANIA DX CONTEST

The New Zealand Association of Radio Transmitters and the Wireless Institute of Australia, the national Amateur Radio Associations in New Zealand and Australia, invite world wide participation in the 1966 VK-ZL-Oceania DX Contest.

OBJECTS:

For Radio Amateurs throughout the world to contact Australia, New Zealand and Oceania stations. **Note:** Australian and New Zealand stations, irrespective of their location do **NOT** contact each other for contest purposes.

WHEN:

Phone: 24 hours from 1000 hours GMT Saturday October 1st to 1000 hours GMT Sunday October 2nd.

C.W.: 24 hours from 1000 hours GMT Saturday October 8th to 1000 hours GMT Sunday October 9th.

RULES:

1. There shall be three main sections to the contest:—
   a. Transmitting Phone.
   b. Transmitting C.W.
   c. Receiving—"Phone and C.W." combined.
2. The contest is open to all licensed amateur transmitting stations in any part of the world. No prior entry need be made. Mobile Marine or other non-land-based stations are not permitted to enter.
3. All amateur frequency bands may be used but no cross band operation is permitted.
4. Phone will be used during the first weekend and C.W. during the second weekend. Stations entering both sections must submit separate logs.
5. Only one contact on C.W. and one contact on phone per band is permitted with any one station for scoring purposes.
6. Only one licensed amateur is permitted to operate any one station under the owner's call sign. Should two or more operate any particular station, each will be considered a competitor and must submit a separate log under his own call sign. (This is not applicable to overseas stations).
7. Entrants must operate within the terms of their licences.
8. **CYPHERS:**
   Before points can be claimed for a contact, serial numbers must be exchanged and acknowledged. The serial number of five or six figures will be made up of RS (telephony) or RST (CW) report plus three figures which may begin with any number between 001 and 100 for the first contact and which will increase in value by one for each successive contact. E.g., if the number chosen for the first contact is 001, then the second must be 002 followed by 003, 004 etc. After reaching 999, start again from 001.
9. **SCORING:**
   a. **For Oceania Stations other than VK or ZL.** 2 points for each contact on a specific band with VK or ZL stations; 1 point for each contact on a specific band with the rest of the world.
   b. **For the rest of the world other than VK or ZL.** 2 points for each contact on a specific band with VK or ZL stations; 1 point for each contact on a specific band with Oceania stations other than VK or ZL.
   c. **For VK or ZL stations.** 5 points for each contact on a specific band and in ad dition, for each new country workedon that bond, BONUS points on the following scale will be added.
   1ST CONTACT—50 points. 2nd contact—40 points. 3rd contact—30 points. 4th contact—10 points.

   For this purpose the ARRL countries list will be used with the exception that the call of W/K, JA, SM, UA will count as "countries" for scoring purposes as indicated above.
10. **LOGS:**
    1. Overseas Stations:
    a. Logs to show in this order—date, time in GMT, call sign of station contacted, band, serial number sent, serial number received, points. Underlining each new VK or ZL call area contacted. Separate log for each band.
    b. Summary sheet to show call sign; name and address (Block Letters); details of station; and for each band, QSO points for that bond, VK and ZL call areas worked on that band.
    "All-band' score will be total QSO points multiplied by the sum of the VK and ZL areas on all bands, while "single-band" scores will be that band QSO points multiplied by VK and ZL cal lareas worked on that band.
    2. VK and ZL Stations:
    c. Logs must show in this order — date, time in GMT, call sign of station worked, band, serial number sent, serial number received, contact points, bonus points. Use a SEPARATE LOG FOR EACH BAND.
    d. Summary to show—name and address in block letters, call sign; score for each band by adding contact and bonus points for that band, and "all bond" score by adding the band scores together; details of station and power; declaration that all the rules and regulations have been observed.
11. The right is reserved to disqualify any entrant, who, during the contest, has not strictly observed regulations or who has consistently departed from the accepted code of operating ethics.
12. The ruling of the New Zealand Association of Radio Transmitters Executive Council will be final.
13. **AWARDS:**
    Australian and New Zealand stations: The NZART will award certificates to the top scorer on each band and the top scorer in each VK and ZL district and silver mounted plaques to the top ZL scorers in both the phone and CW sections.
    Overseas stations: Certificates will be awarded to each country (call area in W/K, JA, SM, UA) on the following basis:
    1. Top scorer using all bands.
    2. Top scorer on individual bands.
    3. Other certificates may be awarded to be determined by conditions and activity.
14. Entries from Australian and New Zealand Stations should be posted direct to:

NZART Contest Manager,
152 Lytton Road, Gisborne, New Zealand.

To arrive not later than December 31st, 1966. Entries from overseas stations should be posted to: NZART, Box 489, Wellington, New Zealand. To arrive not later than January 21st, 1967.

Short Wave Listener Section:

1. The rules are the same as for the transmitting section, but it is open to all members of any S.W.L. Society in the world. No transmitting station is permitted to enter this section.
2. The contest times and logging of stations on each band per weekend are as for transmitting stations, except that the same station may be logged twice on any one band—**once on phone and once on CW.**
3. To count for points logs will take the same form as for transmitting, as follows: Date, time in GMT; call sign of the station heard; call sign of the station being worked; RS or RST of the station heard; serial number sent by the station heard; band; points claimed. Scoring is on the same basis as for transmitting section and the summary should be similarly set out.
4. Overseas stations may log **ONLY** VK or ZL stations but Australian receiving stations may log overseas and ZL stations while New Zealand receiving stations may log overseas and VK stations.
5. Certificates will be awarded to the top scorer in each overseas scoring area and in each Australian and New Zealand call area.

QUALITY KNOBS
HELP FIT
THE MACHINE
TO THE MAN

Designed in Australia by:
POSITRONICS

We will design and manufacture knobs to your requirements, in any quantity.

Contact

ACME ENGINEERING CO. PTY. LTD.
132 BURWOOD ROAD,
BURWOOD, VICTORIA

GET YOUR LICENCE

Do you want to get your licence but cannot attend classes personally? The W.I.A. (NSW. Div.) conducts a Correspondence Course to cover all aspects of the Amateur Licence.

Fees. $14.00 per stage or $36.00 per course.

Enquiries to:

THE COURSE SUPERVISOR,
14 ATCHESON STREET,
CROWS NEST, N.S.W.

SOUND PROJECTORS

Cinevox Prefect 16mm in good working order. 240v operated, complete with speaker and amplifier.

$115.00

CIRCULAR SLIDE RULE

3¾in diameter. Will do the same work as the conventional slide rule. Instruction book included.

$1.25 each. Post 10c

REFLECTOR GUNSIGHT

Contains these lenses:
1 Lens 1in Focus, 1½in diam.
1 Lens 1 11/16in Focus, 1¼in diameter.
1 Air-spaced Lens, 1¼in diam.
1 Filter Lens, 1 Graticule,
1 Lampholder.

$1.85 each

Post: N.S.W., 30c; Interstate, 40c.

PMG TYPE TELEPHONES

Standard desk type with magneto calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.

$23.00

(2 TELEPHONE SETS)

30c cartage to rail. Freight payable at nearest attended railway station.

AERIAL CAMERAS

F.24 Mark IV 2.9 Lens, stops 11, 8, 5.6, 4, 2.9.
With 3in x 8in F1 Dallmeyer Lenses complete with wooden case.

$39.00

50c Cartage to Rail., Freight payable at nearest attended railway station.

SHIPS' CLOCKS

(No bell). Smith's 8-day, fully jewelled. Original cost $120. Special 7in brass $25. 10½in Seth Thomas splash-proofed bakelite

$30

Post N.S.W., 70c; Interstate, 95c.

ECHO SOUNDER

Depth and Fish Finder. Transistorised, with Neon Flasher Indicator, complete and Guaranteed.

$85.00 Post $1.60

12 CREED TELEPRINTER

Tape printers model 47.R, 240 Volts operated.

$35.00

TELEPHONE WIRE

21 gauge copper, plastic covered. Ideal telephone or bell wire. 1,320ft coil of twin (equal ½ mile). $7.00 per coil.
Post, N.S.W. 70c; Interstate $1.20.

3000 TYPE RELAYS

P.M.G. 200 Ohm — 1,500 Ohm Coils, $1.25 each.

2-WAY RADIO

NUMBER 22 (AUST.)

Untested without meter or leads, with power supply less relays. $15.00. 50c cartage to rail. Freight payable at nearest attended railway station.

AMPLIFIER

Subminiature 4-Transistor, Audio Push-Pull.

$7.00 Post 50c

GOOSE NECK LAMP

NEW. IDEAL FOR DESK or WORK BENCH. Adjustable shade, strong metal lacquered base and frame. Height 18in. Complete with lead.

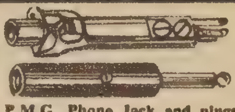
$1.25

Post and packing. $1.00.

DRAFTING MACHINE

Genuine Swiss-Wiles (Without Scale).

$19.50 Post $1.20



P.M.G. Phone Jack and plugs. 25c each, 45c the pair.
Post 7c.

NIFE CELLS

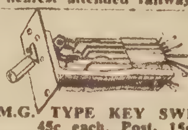
1.2 Volt fully charged, 4in x 3in x 1in 4 AH.

$1.00 each

Post, N.S.W., 25c; Interstate, 35c.
1.2 volts 15 AH, 8in x 4in x 2in, $2.95.
2.4 volt 10 AH, 6in x 2½in x 2in. $2.50.
Post, N.S.W., 30; Intersrate, 40c.

PERSPEX

Slightly domed shape, 16in x 12in, $1.55. 2ft 6in x 18in tapering to 6in, $1.75. 2ft 6in x 2ft, $2.45. Domed approximately 3ft 6in x 2ft, $5.50.
50c cartage to rail. Freight payable at nearest attended railway station.



P.M.G. TYPE KEY SWITCHES.
45c each. Post, 15c.

VALVES

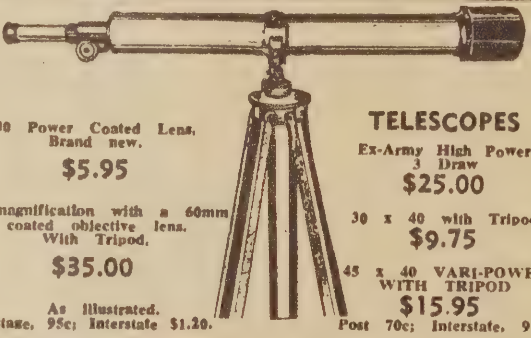
BRAND NEW

IN CARTONS.

Special discount for quantity

6SN7GT	95c	6AG5	50c
89	$1.00	X61M	$2.20
12SA7	$1.25	CV850	$1.50
6H6	45c	18H6G	30c
41	$1.25	832	$5.00
5U4G	95c	6F13	75c
77	$1.00	6AK5	$1.50
VR150-30	$1.00	6X4	$1.00
		6F8	75c
5CP1	$3.95	6N7	$1.00
EF50	35c	12SK7	50c
6U7	75c	VR1120	50c
V1103	$1.00	VR118	75c
VH120	75c	VR65	25c
1L4	$1.0	6R7GT	50c
5Y3	$1.50	VT4C	75c
6C4	50c	AU5	$1.00
CV2184	$2.25	80	$1.25
		6AK5W	$1.50

PLEASE ADD POSTAGE ON ALL ARTICLES.



30 Power Coated Lens. Brand new.

$5.95

60 magnification with a 60mm coated objective lens. With Tripod.

$35.00

As illustrated.
Postage, 95c; Interstate $1.20.

TELESCOPES

Ex-Army High Power 3 Draw

$25.00

30 x 40 with Tripod

$9.75

45 x 40 VARI-POWER WITH TRIPOD

$15.95

Post 70c; Interstate, 95c.

HIGH STABILITY RESISTORS

I.R.C. brand new ½w., 1w, 2w, tolerances between 1 and not exceeding 5% including 100, 360, 560, 750, 15K, 22K, 27K, 100K, 180K, 220K, 560K, 820K, ohms. Usual price 40c each, 50 assorted different values for only

$3.75 Post 15c.

GENUINE VARIACS

0-115 V.A.C. 18 Amps, $29 each, or couple two together for 240 V.A.C.

The two for $45

Genuine American Zenith Variacs

0-115 V.A.C. 7.5 Amps, $19.50 each or couple two together for 240 V.A.C.
The two for $36.
50c cartage to rail. Freight payable at nearest attended railway station.

522 TRANSCEIVERS

100 to 150 m/cs.

$35.00

TR1934 TRANSCEIVERS

100 to 125 m/cs.

$33.00

FRACTIONAL 240 VAC MOTORS

1/25 h.p., new, with coupled 2-speed gearbox, 1425 and 300 r.p.m. Ideal for rumbler, etc.

$20

Post N.S.W., 70c; Interstate, 95c.

AWA OSCILLOSCOPE

Calibrated with delay time base. 5in, 240 vac., perfect.

$195.00

C.M.A. CABLE

240 volt 3/.036 black, new and perfect. 100 yds. rolls, $3.00, 6 or more.

$2.50 a roll

30c cartage to rail. Freight payable at nearest attended railway station.

MICROMETERS

Brand new Goodell-Pratt, 0 to 1in, $7.50; Slocombe, 1in-2in, $7.85; Starrett 1in-2in, $9.85.
Post, 32c.

CHOKES, 7.5H, 60mA 95c
VIBRATORS, 6 volts, 7-pin, 75c each.
UNISELECTORS. 4 BANK HOMING TYPE $4.00
INVERTERS, 26v-115v 2Kw 400 cycle $9.50
HAND MICROPHONES, with Press-to-Talk Switch .. 95c ea.
Post, N.S.W., 25c; Interstate, 30c.
INSTRUMENT TRIPODS, sturdy wooden frame. Telescopic Extend to 4ft 6in $13.00
SELSYN MOTORS MAGSLIP Mk. II .. .. $5.25 ea.
No. 19 2-way radios, with hand set, power supply, leads, $35.00
Meggers, bridge type, complete and tested $75.00
EVERSHED and VIGNOLES, 500 volts.

H.T. TRANSFORMERS

2,000/0/2,000 volt. Primary 28 volt 50 cys. rated at 1.75 Kva. Ideal linear amplifier, etc.

$27.00

BINOCULARS

PRISMATIC. Coated Lenses. Brand new. Complete with case

8 x 30	$19.5
7 x 50	$26.5
10 x 50	$27.5
12 x 50	$28.5

Post, N.S.W. 70c; Interstate, $1.2

SPECIAL ARMY RELEASE.

TELESCOPES

ALL LENSES "ASTRONOMICAL" QUALITY.

General and Marine Use

4 x 40 Genuine HANDLEY Cost $60.00. Our Price, $6.50
7 x 40 GENUINE OTWAY ANGLE TELESCOPE. Cost $90 Our Price $9.8
15 x 40 variable Power Otway $15.50.
Freight payable at nearest attended railway station.

PROJECTOR LAMPS

BRAND NEW PHILIPS
240 volts. 750 watts.
Base down.

$2.50

Post 13 cents.

BUBBLE SEXTANTS

Mark 9 without bubble $9.56
With bubble $25

RECORDING TAPES

SCOTCH BRAND.
EX-WOOMERA.
SLIGHTLY USED.
PERFECT ORDER.

Can be used for home video, tape recording equipment, etc.
2,400ft 12in Reel ½in Top Grade. Cost $14.50. Our price $7.50 roll. Post 70c; Interstate, 95c.
Also same in ¼in. Ideal for professional quality audio recording.
1200ft 7in reel ¼in $2.75. Post 12c.
600ft 5in reel ¼in $1.68. Post 12c.
200ft 3in reel ¼in 65c. Post 10c.

SCOOP PURCHASE

Gramo. Motors, New. Made in U.S.A. 4-speed. 240 volt A.C. 50 cyc. Only $2.75 each.
Post, N.S.W., 30c; Interstate, 40c.

240-110 VOLT 6KVA TRANSFORMERS

Encased, including switches, as new. $50.

Top grade, fully enclosed transformer, 1 Kva primary 218/240 vac. 50 cycs. secondary 6 volt, 37 volts, 53 volt, 60 volt, $30.

LEAD ACID BATTERIES

New 2 volt 1.5 amp. $1.75, 12 volt 0.75 amp. $3.75.
Post, N.S.W., 25c; Interstate, 30c.

SPECIAL lucky dip valve offer. 15 new valves in cartons for only $2.00. We haven't got time to sort them, so you reap the benefit. Post, 30c.

SOLENOIDS

Plunger Type 12V 300M.A. Suit electric camera control, MINIATURE TRAINS, radio, etc. $1.25. Post, 10c.
200 Mill. amp., 24 volt, 1/8in push movement.
$1.25. Post, 10c.

BATTERY CHARGER

6 or 12 volt, 2½ amp. $9.95.
Post, N.S.W., 70c; Interstate, 95c.

TELEPHONES

Sound Powered. Can be used as Microphone and Receiver. New. With 50ft cable.
$3.85 pair.
Post, 25c; Interstate, 40c.

Deitch Bros.

70 OXFORD STREET, SYDNEY

SORRY, NO C.O.D.

re are are about 30 members taking ctive part at present but there is for many more. Those interested l contact Geoff.

WEST AUSTRALIA

assist the holders of limited licences thers interested in learning the Morse the Council of the West Australian on has decided to commence a morse ng course.

invitation is extended to all persons sted to contact the Secretary, Mr N. enfold, Box N.1002, G.P.O. Perth. imes and place will be arranged when known how many wish to avail selves of this facility.

uncil is also arranging for members to Wayne Green W2NSD who will be ng Perth on the 13th and 14th Sep- er. Wayne is a well known amateur e United States and is the Editor of an American Amateur Journal, also " which is a VHF Bulletin. Details e arrangements can be obtained from ecretary.

TASMANIA

the Annual General Meeting of the anian Division VHF Group, the Elec- of officers for the forthcoming year lecided.

ose elected were:
esident, VK7LY, *See below.
ce-presidents, VK7ZAO, R. K. Emmett; 7ZTM, *See below.
cretary-Treasurer, VK7TX, B. M. Muir.
ws Officer, VK7ZFL, F. L. Powell.
search Officer, VK7ZAS, G. C. D'Em-
HF Bulletin Officer, VK7ZAV, M. L. er.
R. Correspondent, VK7ZMD, D. R. sland.
oadcast Officers: 6 Metres, VK7ZMD, . Marsland; 2 Metres, VK7ZJG, J. F. e.

t is regretted that the names of VK7LY VK7ZTM are not included. They are rently recently issued call signs and ot appear in any listing at the time of piling these notes.

IF MOONBOUNCE EXPERIMENTS

the May issue of these notes mention made of 144MHz moonbounce experi- s being carried out between Birchip, orth-western Victoria, and the Stanford ersity in California. These experiments continued and Ray Naughton, VK3AT, rts that more outstanding results have achieved.

rther tests were carried out with the fornian stations and on June 17th Ray able to copy, at almost readability five, MHz signals via moonbounce from IYC. On the same evening Ray was to copy his own 144MHz signals as cho from the moon.

n June 21 signals were again audible Birchip, and on this occasion the call used was K6CLM. Both K6MYC and LM are located at Stanford University, miles south of San Francisco, Cali- ia, and both use a 256-element phased- y aerial for these 144MHz experiments.

n checking recordings made on June , K6MYC and K6CLM were able to tify signals from VK3ATN. A further rt to hand is that W2AZL, located in Jersey, copied VK3ATN at reada- y five on June 17th. W1BU in Massachu- , using a 256-element phased-array, and IWA, using the 60-foot dish aerial at Bell Laboratories, also copied 144MHz signals via moonbounce from ATN.

ne rhombic aerial used by Ray for the nbounce experiments is on a bearing 5 degrees true, and from Birchip this goes through Griffith, Dubbo, Tam- th, Armidale and Lismore in New South es. The gain of the antenna is in excess 0dB.

ne total length of the rhombic antenna 00 feet and is a four-section array, feet in each leg, 35 feet high and feet wide. A track at one end allows ement a little over 1 degree. Eventually there will be a track at each end allowing it to be moved further north to 54 degrees true, thereby putting the lobe much closer to Brisbane.

The frequency used by VK3ATN on the moonbounce experiments is 144.090MHz within 20-30 cycles, but usually the station operates on 144.1MHz as this is much easier to locate when using the facilities usually available to most amateurs. The moonbounce experiments can only be made on one or two days each month for about 15 minutes each day, due to the location of the moon in relation to Birchip and California.

Ray would like to carry out tests with anyone located along the line of his antenna lobe to enable further work to be carried out under direct-contact conditions. The bearing to Birchip would be 235 degrees true. Anyone interested should contact Ray on the 3.5MHz or 7MHz bands.

During a 7MHz contact with VK3ATN, a recording of the moonbounce signals from California was relayed to, and recorded by, VK2APQ in Sydney. Despite the losses introduced by retransmission and recording via the 7MHz channel, the moonbounce signals could be distinctly heard. Several who have heard the recording have been amazed at the results Ray has achieved.

SATELLITE TV

An amateur radio operator in Moorestown, New Jersey, U.S.A., Wendell Anderson, an RCA enginer, has been successful in producing pictures transmitted from a weather satellite, on home constructed equipment.

On March 2 he began receiving weather photos from the U.S.A. Environmental Science Services Administration's ESSA 2, the twelfth in the Tiros weather satellite series.

The success of Wendell's experiments has proved that amateur operators anywhere in the world can obtain good weather pictures by adding a few relatively inexpensive items to their existing receivers.

Since the U.S.A. Weather Bureau has encouraged organisations in other countries to make use of the information transmitted by the satellite, this could well be the first of many such amateur stations that will eventually be in operation throughout the world.

The home constructed receiving station was built at a total cost of less than $600. Of this about $250 was required for the picture receiving equipment added to the amateur receiving equipment. The antenna used was a normal type VHF array. The signals from the satellite are recorded on magnetic tape and transferred to film, using a microscope fitted with an argon electric light bulb.

The bulb microscope apparatus, operating in the dark, scans an 8in x 10in sheet of film, wrapped around a rotating cylinder. The cylinder is an ordinary rolling pin with the handles removed, and is operated by a toy-sized electric motor, while a second motor of the same type drives the microscope horizontally very slowly so that it can register on film the numerous lines that make up the weather picture. ("RCA Electronic Age," Spring, 1966.)

WORLD VHF DX RECORDS

The greatest confirmed distance records established by amateur radio stations for two-way communication are as follows: —

50MHz

12,000 miles: LU3EX—Argentina to JA6FR—Japan, March 24, 1956.

144MHz

5,250 miles: OH1NL—Finland to W6DNG—U.S.A., moonbounce, April 11, 1964.

2,540 miles: W6NCZ—U.S.A. to KH6UK —Hawaiian Islands, July 8, 1957.

220MHz

2,540 miles: W6NLZ—U.S.A. to KH6UK —Hawaiian Islands, June 22, 1959.

420MHz

5,092 miles: KH6UK—Hawaiian Islands to W1BU—U.S.A., moonbounce, July 31, 1964.

1,150 miles: WA4KFW—U.S.A. to W5LOU—U.S.A., April 12, 1965.

1,215MHz

5,092 miles: KH6UK—Hawaiian Islands to W1BU—U.S.A., moonbounce, August 9, 1962.

2300MHz

170 miles: W1EHF/P—U.S.A. to W2BVU/P/W1—U.S.A., July 1, 1963.

3300MHz

190 miles: W6FE/P—U.S.A. to W6VIX/P —U.S.A., June 9, 1956.

5650MHz

120 miles: WB6JZY—U.S.A. to WA6KKK—U.S.A., September 25, 1965.

10,000MHz

265 miles: W7JIP/P—U.S.A. to W7LHL/P—U.S.A., July 31, 1960.

Above 30,000MHz

500 feet: W6NSV/P—U.S.A. to K6YYF/P—U.S.A., July 17, 1957.

I.T.U. NEWS.

A new director of the I.T.U.'s International Radio Consultative Committee (C.C.I.R.) was elected at the XI plenary assembly of that committee. Following three ballots for the position, Mr Jack Herbstreit of the U.S.A. was elected and he will take up office in Geneva later this year.

The last director of the C.C.I.R. was Dr Ernst Metzler, of Switzerland, who died in 1963. Since then, the post had been filled

ACOS MICROPHONES AND MICROPHONE INSERTS

MIC 39-1. The famous crystal stick microphone.

Frequency response .... 30-12,000 c/s.
Sensitivity .... 62 dB ref. 1 V/dyne/cm².
Recommended load .... 4.7 M Ohm for above response.
Price: £7/19/6.
MIC 39 DYNAMIC. With a dynamic insert. High and low impedance matching.
Frequency response .. 80-10,000 c/s. ± 3 dB, and approx. 10 dB down at 50 c/s. and 15 kc/s.
Sensitivity ...... Low impedance connection (nominal 200) 80 dB ref. 1 V/dyne/cm² on open circuit. High impedance connection (nominal 50k) 54 dB ref. 1 V/dyne/cm² on open circuit.
Price: £18/-/-.
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E.A., Sept, 66.

by a director ad interim, Mr Leslie Hayes of the United Kingdom.

Born in Cincinnati, Ohio, in 1917, Herbstreit attended public schools there entered the University of Cincinnati in and graduated with a Professional Elec Engineering Degree in 1939.

In 1940 he joined the Federal Com cations Commission and since then been associated with the Department o Army and the National Bureau of Stan and became a familiar figure at internat meetings in the field of radio commu tions during the past 17 years.

He has made extensive research int measurement of atmospheric noise and the attenuation of radio signal jungles in Panama and the southwest fic, as well as cosmic radio noise VHF UHF propagation.

At the International High Frequ Broadcasting Conference in Mexico, he was responsible for the preparatio the radio propagation charts, which wer forerunners of the present propagatio formation used by the International quency Registration Board (I.F.R.B.) t termine the interference potential of and prospective uses of the HF spectrum.

In 1959 he was given the Harry Diar Award for "Original research and le ship in radio wave propagation." Th the highest honour that can be grante a government scientist in the field of ele magnetic telecommunications in the U States. He was admitted to the ran Fellow in the Institute of Radio Enginee 1958 and holds a similar rank in American Association for the Advance of Science.

DX NEWS

DX operators are asked to assist in ing the task of QSL officers a little e by passing on any information that coul of value when despatching QSL cards seas.

It is suggested that if the call sign QSL manager is given by a rare DX sta it would be of great assistance to divis Bureau officers if members would those details on their outgoing cards.

This will eliminate the possibility of cards being sent to the wrong destin and will definitely save time in trans the station concerned.

Another matter which is giving managers additional work is the char prefix in call signs. It is becoming qu task to keep up with them all. For exa during a period of about eight mo Singapore has changed from VS1 to and then to 9V1. Noting such change new area prefixes on outgoing cards also assist.

DX CONTEST RESULTS

The scores of several well-known Au lian DX contestants are listed in the re of the "1965 CQ DX Contest." More 300 logs were submitted for this conte substantial increase over previous years.

The Australian stations listed were:

VK3ATN, T. R. Naughton, 18 points. All bands.

VK2NN, T. Preece, 77,770 points. bands.

VK6RU, J. Rumble, 25,364 points. bands.

VK2APK, D. Kiesewetter, 20,394 pc 14MHz.

VK5GG, G. A. Gormly, 4,773 pc 14MHz.

VK4SD, A. H. Sharland, 1,932 pc 14MHz.

VK3SM, A. M. Crewther, 1,872 pc 21MHz.

The overall winner of the single ope section was DL3LL, a German station scored 692,208 points using all bands head the list for the third year in succes

In the single band section, SM5E of Sweden, scored 672,208 points, oper on the 14MHz band.

GI3CDF, in Northern Ireland, wor on the 3.5MHz band, scored an ama 24,900 points, while G3NLY, in Eng scored 9,702 points on the 7MHz band.

uth Radio Scheme

e time ago various suggestions were by the Youth Radio Scheme Co-tor to the Committee set up in New Wales to administer the Duke of urgh's Awards. Candidates for these s must engage in some hobby activity a specified period and must make e progress in the selected field.

phase of the awards is called uits" and "Hobby Radio" is included list of activities acceptable to the sers. The awards were designed origi-for English conditions and the existing uses are based on recommendations by various organisations in the United om. However, the local Committee ought to adapt the syllabuses to meet alian situations.

a result, the Australian Youth Radio e was privileged to offer suggestions, subsequently have been endorsed by pecial Committee set up by the tion of Radio and Electronic eers.

s hoped that the final word on these sals will be received shortly from the of Edinburgh's Award Committee. members will then be able to take tage of this important youth activity vill seek to complete the requirements he bronze, silver and gold medals ble to those who succeed in the s aspects of training and performance.

CAMP TECHNOLOGY

organisers of the Camp Technology t, to be held during the Christmas y at Mount Victoria in N.S.W., are y busily engaged in making prepara-

will be recalled that this form of ng started about two years ago, and ast Christmas the numbers doubled. anticipated that even more will wish end this year, therefore early appli-will be necessary to ensure accept-

se interested in taking part in the session should write to or telephone om Mayne, St. Aidans Road, Dundas, for full details of the training am and other relevant details.

Y.R.S. LAPEL BADGES

nsideration is being given to the tion by the Victorian Y.R.S. that there d be a special Y.R.S. badge available mbers at cost price, so that members have a means of mutual recognition.

nments on this suggestion have been ed from most of the State Y.R.S. visors. However, individual Club rs who would like to offer comments d contact their State Supervisors with stions on design and other require-

the end of July there were 44 Y.R.S. and postal Groups registered with .R.S. in New South Wales. This is to the number registered for the of 1965 and indicates that a new d will be set.

Queensland the State Supervisor re-that, by 30.6.66., 17 active clubs were ered there. Also, that five ex-Y.R.S. ers hold limited licences and one a cence. In addition, two club instructors gained limited licences.

eral donations of radio components been made to the scheme and have distributed to various Clubs. These le a considerable quantity of resistors, itors and miscellaneous components Standard Telephones and Cables Pty. arranged by Mr R. Davidson. A ity of computer component spares included valves and resistors, came Mr H. Hepburn, Federal Vice-ent of the W.I.A. and a parcel of resistors, won as a prize by the Mr H. Burtoft VK2AHH, at a recent Day.

THE JAPANESE AMATEUR RADIO LEAGUE

In Region III, the society having the largest membership in the Amateur Service is the Japanese Amateur Radio League—JARL. There are about 38,000 licensed amateurs in Japan and of these 13,200 are members of the JARL. There is no age limit for the issue of a licence but the licensee must be a citizen of Japan.

There are four classes of licence and the maximum power limit is 500 watts. The amateur radio examinations are held twice a year in April and October by the licensing authority, The Ministry of Posts and Telecommunications.

The requirements for the four classes are:

First-class:

Morse Code, send and receive for a period of three minutes each; 10 words per minute in the Japanese code, 12 words per minute International code.

Laws and Regulations: Five questions, essay type, 2-hour time period.

Wireless Engineering: Five questions, essay type, 2½-hour time period.

Second-class:

Morse Code: Sending and receiving for a period of two minutes each, International code at nine words per minute.

Laws and Regulations: Five questions, essay type of two hours' duration.

Wireless Engineering: 10 questions in a two-hour period.

Telegraph Class:

Morse Code: Sending and receiving for a period of one minute each, International code at five words per minute.

Laws and Regulations: 10 essay-type questions in a one-hour time period.

Wireless Engineering: 10 questions in a one-hour time period.

Telephone Class:

Laws and Regulations: 10 questions in a one-hour period.

Wireless Engineering: 10 essay-type questions in a one-hour time period.

The code test is of common words with no cyphers and can be sent either on the straight key or bug-type key. Electronic keyers are not allowed.

The frequencies, modes and power allowed for the four classes are:

Frequency	Mode	Power and Class
1,880KHz	A1	200 watts. First-class only.
3.5 MHz to 3.575MHz	A1, A3, A3a, A3h, A3j	10 watts all classes. 100 watts second-class. 500 watts first-class.
7.0MHz to 7.1MHz	As above	As above.
14.0MHz to 14.35MHz	As above	As above.
21.0MHz to 21.45MHz	As above	As above.
28.0MHz to 29.7MHz	A1, A2, A3 ,A4	50 watts. If necessary 100 or 500 watts permitted for the first or second class.
50.0MHz to 54.0MHz	A3a ,A3h ,A3j	
144MHz to 146MHz	F1, F2, F3, F4	
430MHz to 440MHz	F1, F2, F3, A3, A5, A3c, A9	50 watts for first and second-class. 10 watts for Telephone and Telegraph class.
1,215MHz to 1,300MHz	A1, A2, A3, A4	1 watt. If necessary 10 watts for Telephone and Telegraph class. 500 watts for first-class licence.
2,300MHz to 2,450MHz	A5, F1, F2, F3	
5,650MHz to 5,850MHz	F4, F5, P1, P2d	
10.0GHz to 10.5GHz	P2e ,P2f P3d P3e	
21.0GHz to 22.0GHz	P3f and P9	

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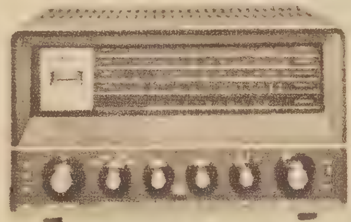

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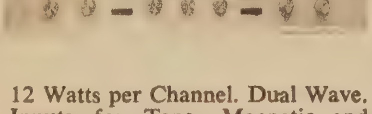

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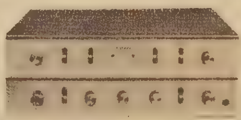

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Current: 250uA, 250mA.
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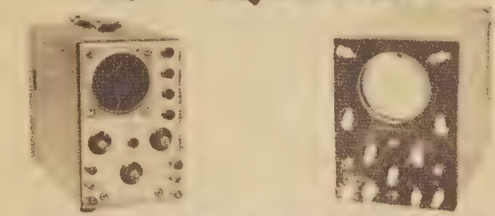

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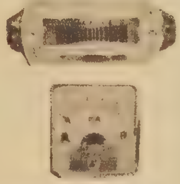

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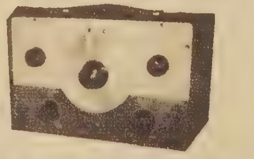

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Weight — 9lb.
Complete with Instruction Book circuit.

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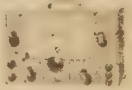

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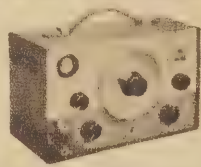

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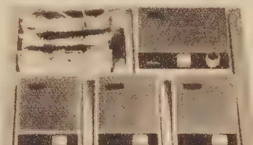
38 K.V. output.
Complete. Tested.
Negative earth.
$33.50 £16/15/-
Positive earth.
$41.50 £20/15/-
State voltage and polarity.
Post., N.S.W., 75c; Interstate, $1.25.

CITIZENS BAND

27.240 Megs.
10 Transistor Transceivers.
100 M.W. output.
$45.00
1. Watt 13 Transistor 1 channel with squelch.
$65.00 each (£32-10-0)
1 watt. 15 transistor, with squelch provision for two channels. Range to 10 miles under ideal conditions.
$80.00 £40 each

INTER. COM. UNITS

2 Station Transistorised
$11.50 £5/15/-
4 Station, including Master
$20.25 £10/2/6



New Telephone Amplifier

Transistorised.
$11.50 £5/15/-
Post 35c.

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New 10-channel Tuners.
$15.00 £7/10/-
Post 75c.

LATEST 4-SPEED PLAYERS

240V A.C. Mono	$11.50
240V A.C. Stereo	$17.00
Battery Mono	$19.50
Battery Stereo	$21.50
Battery Mono 45 r.p.m. in Cabinet	$9.25

Post., N.S.W., 75c; Interstate, $1.25.

ELECTRIC GUITAR

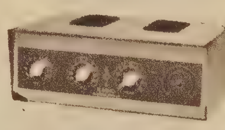
Pickup Units	$8.75
Accordion Pickup Units	$8.75
Harmonica Pickup Units	$1.95

Post., N.S.W. 40c; Interstate, 75c.

Send for full details on Radiogram Chassis, TV and Amplifiers.

AMPLIFIERS

Public Address Range 240V-AC



MINIATURE P.A. AMPLIFIER.
15 WATTS OUTPUT.

Multi Match Ferguson O.P. transformer input for crystal mike and pick-up with electronic mixing. P.P. EL.84 output	$39.50
30 Watt. As above EL34 P.P.	$53.50
40 Watt. As above EL34 P.P	$79.50
60 Watt. As above EL34 P.P.	$98.50

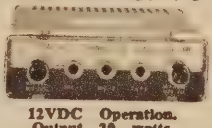
LINE OR VOICE COIL TRANSFORMERS.
MULLARD HI-FI RANGE.

5/10 with pre amp base and treble boost. Ultra Linear output	$43.50
5/20in. As above	$65.50

BATTERY-AC OPERATION

6 valve 6v plus 240v-10 watt	$55.50
7 valve 12v plus 240v-12 watt	$59.75
7 valve 12v plus 240v-25 watt	$71.75

TRANSISTOR P.A. AMPLIFIER C.A.-512



12VDC Operation.
Output 20 watts.
Current consumption at max. output, 2.2 amps.
Input. High imp. mic. Also 600 ohms and tape.
Independent gain controls.
Output: Imp. 4-8-16 ohms.
Freq. Response:
200 cps—6000 cps.
Dimensions: 2in x 6¼in x 8½in.
Complete with instruction book with circuit. All plugs.
PRICE $57.50

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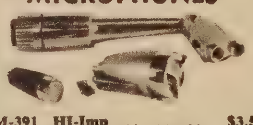

DM-391 HI-Imp	$3.50
DM-175 HI-Imp	$4.75
DMS-3 HI-Imp	$5.50
DM-305. 600 ohms or HI-Imp. Suitable stand mounting	$9.75
DM-304 Dynamic Cardoid. 50 ohms or HI-Imp. Suitable stand mounting	$15.75
D.M. 307 HI-IMP.	£7/10/-
CM-10 Crystal HI-Imp. Suit stand mount	$5.75
DM-108 Cardoid	£5/17/6
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3 Section Floor Stands	£3/12/6

Post., N.S.W., 25c; Interstate, 35c.

WIDE RANGE LIGHTWEIGHT STEREO PICK-UPS

Ceramic Units, Sapphire Styli	$7.
Diamond Styli	$10.
Universal Ceramic Stereo Cartridge, Sapphire Styli	$2.
Diamond Styli	$6.

NEW WIDE RANGE SPEAKERS

15 ohm. Twin Cone

8in	$7.
12in	$7.
5in	$4.
5in Tweeter	$3.
4in Single Tweeter	$2.
12in Heavy Duty 20 watt	$15.

P.A. REFLEX HORN

WITH UNITS

5 Watt 8 ohm	$14.
10 Watt 8 ohm	$26.
35 Watt 15 ohm	$18.

N.B.: As these are American ratin divide the wattage by 2.

STEREO RECORD CHANGERS

1965 model, 4-speed.
$21.50 £10/15/-
De Luxe Model.
Fully machined and balanc Heavyweight turntable. Ceran cartridge.
$27.50 £13/15/-
Post. N.S.W., $1.25; Interstate, $1.

STEREOPHONIC HI-F HEADPHONES

With padded earpieces
SPECIFICATION:
Frequency Response: 25-17,000 c
Nominal Power 1 watt.
V.C. Imp. 8 ohms each chann
$7.75 £3/17/6
Post., 50c.

PHILIPS DISC JOCKEY

4-speed Players.
6V, D.C. OPERATION.
MONAURAL CRYSTAL HEAD
$9.75 £4/17/6
STEREO
$11.75 £5/17/6
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MORSE KEYS

New lightweight, fully adjustable un
$1.25
As above with buzzer.
Complete Morse practice set.
$1.65

LISTENING AROUND THE WORLD

Art Cushen's monthly report on long-distance short-wave, television and broadcast band reception.

Broadcasting Service for New Hebrides

egular transmissions began August 2 from a new station at ila, New Hebrides. A broadcasting service for this terri- ›ry was first proposed some years ago, at which time some experimental broadcasts were heard.

etter from the chief engineer of the informs us that a very simple but r broadcasting service was established ugust 2. The station operates on .Hz 0015-0115GMT and on 3905KHz 715 approximately and the service the air Tuesday, Wednesday, Thurs- nd Friday only. The 500W transmittter a dipole aerial and is sited at Port The transmitter is normally used for and telegraph services, which limits me available for broadcasting. Pro- are being prepared on tape and o the radio station for transmission. probable that at first the same pro- will be transmitted at both scheduled nission times. Information on this is Mr R. A. Robinson, chief engineer Radio Telecommunications Depart- at Vila.

New Hebrides territory is jointly istered by France and Britain as a minium. A statement from the British ncy at Vila said that it was planned erate a limited broadcasting service, would be operated jointly by the h and British administration. The plan ed a recommendation made in nber, 1965, to the Resident Commis- s by an advisory committee.

first heard this station on test some ago when using 3905KHz, but at ime it was broadcasting at a much hour. The time, 0615-0715, will ly be too early for reception in Aus- and New Zealand, but as the station ses its schedule the prospects of ion will improve.

VILNA ON 11710KHz

lish language programs from Lithu- (now part of the U.S.S.R.) are well ed in New Zealand at 2230GMT, on Friday and Sunday a 30-minute m is broadcast from the capital, on 11710 KHz. The station is also on 6200KHz.

na, the capital of the former Republic thuania, which was inducted into the Union after World War II, has been noted in English before. The uses an interval signal and then rch theme to open, and identifies dio Vilna in Lithuania and lists the ncies 6200, 7180, 9740 and 11710KHz.

grams consist of news followed by and then typical Lithuanian music, off at 2300GMT. Signals are excel- and it seems either that new trans- s have been put into service or that rogram is retransmitted by Radio w, which opens on 11710KHz at Vilna, or Vilnayus, adds Lithuania to the growing list of short-wave countries to be tuned with English transmissions.

ASCENSION RELAY OPENS

The long-awaited opening of the B.B.C. relay base on Ascension Island, in the South Atlantic, took place on July 1, when the station commenced its initial service on 15350KHz. The station is on the air 1745 to 2245GMT and makes no local announcements, all programs being relayed from London. This 250kW transmitter, the first of four to be put into service, is being used for field-strength measurements in the African area so that the effectiveness of the beams on this continent can be evaluated.

The station carries the World Service from 1745 and then follow programs in Hausa and French. At 1945GMT it rejoins the World Service to sign off at 2245GMT. The beam is on West Africa at present, but the relay station plans eventually to beam its programs to the whole of Africa and also later to Central and South America when the beam will direct programs in the opposite direction.

RADIO MIL—4940KHz

After many months of inactivity, Radio Mil, in Santo Domingo, Dominican Republic (call sign HIBE) has been noted in New Zealand to sign off at 0507GMT. Dene Lynneburg, of Wellington, first drew our attention to this signal and we now find it at fair level after the frequency is clear at 0457GMT when Radio Nacional de Ecuador in Quito closes transmission on 4945KHz. Radio Mil, on 4940KHz, gives a long list of other stations which are also carrying its program on both BC and SW bands and leaves the air with the Dominican National Anthem.

Its several years of absence may have been caused by the unrest in the Dominican Republic, and possibly it has been authorised to return to the air by the newly established Government.

VL9CH MOUNT HAGEN

The sixth station to be brought into operation by the Australian Administration of Papua-New Guinea is VL9CH at Mount Hagen, which is now on the air with 250W on 2450KHz. The station is scheduled to broadcast 0700-1100GMT and carry programs in English and the vernaculars. This is one of the last to come into operation in the plan to bring a radio service to the Papua-New Guinea area, which is also backed up by the A.B.C. stations at Port Moresby.

The new station is the sixth to open, and as reported in these pages in October, 1964, it leaves only one station (Madang) to begin operation to finalise the present plan for radio services to the Papua-New Guinea area.

ZAMBIA SCHEDULE

The latest schedule of the Zambia Broadcasting Service has been supplied by Barry C. Williams of Auckland, N.Z. The station's General Service lists the station as on the air weekdays 0400-0445 on 2455 and 3275-KHz, 0445-0630 on 3275, 0630-1430 on 4911, 1430-1800 on 3275, 1800-2105 on 2455 and 3275KHz. The Sunday transmission schedule is the same as weekdays, but opening is 0500 and sign off is 2010GMT. The address of the station is Zambia Broadcasting Service, Broadcasting House, P.O. Box RW15, Ridgeway, Lusaka.

FIJI FREQUENCIES

The frequency reshuttle of the Fiji Broadcasting Commission in Suva has resulted in changes to both medium and short-wave channels. The station when opening at 1800GMT gives the complete list of its seven transmitters and states that its Fijian language program is broadcast through station VRH2 Suva 710KHz and over Radio Fiji VRH7 6005KHz, VRH9 3284KHz.

The English language programs are broadcast on VRH Suva 560KHz, VRH8 Lutoka 890KHz, and over Radio Fiji VRH6 on 5955KHz and VRH8 3230KHz. All seven transmitters carry these programs to 2000GMT when there is a switch of language transmission on some, although the frequencies used remain the same.

AFRICAN SIGNALS

Some excellent reception of signals from Africa is again reported by Australian readers Bob Padula and Barry Hewit of Victoria, who have been hearing many of these stations on the 60, 90 and 120M bands.

Malawi uses the frequency of 3370KHz and the station closes at 2200GMT, station identification at this time being preceded by a five-minute news bulletin in English. South Africa's Commercial Service on 3250-KHz is noted at 2030 with frequent identification, to sign off at 2200GMT. Ghana on 3350KHz is using this frequency at 2100GMT when a news bulletin in English is broadcast. Rhodesia, from Salisbury, has been tuned on 2425KHz to sign off at 2200GMT when identification is given; power is listed at 2500W and the frequency is used for English and vernacular broadcasts.

HJIW USING 6095KHz

A change of frequency has resulted in good reception of a new Colombian station, "La Voz del Centro," which is now using 6095KHz, the call sign being HJIW. This station has been heard at 0950, testing with Latin American music, and the station opens at 1000GMT. The opening announcement gives the slogan, call sign and location which is in Espinal in Colombia. The station then commences a program of popular Latin American music and the slogan is given with the time after each recording in Spanish.

The station, formerly scheduled on 4855-KHz but never heard on this frequency, uses the frequency formerly assigned to Radio Colosal in Neiva, Colombia. The latter station may have switched frequency or gone off the air. HJIW suffers some slight sideband interference from VL16 Sydney on 6090KHz, but this is not very severe.

HISD USING 6090KHz

Reception of the Santo Domingo station "Radio Sto. Domingo Television" on the new frequency of 6090KHz has been good at 1000GMT. The same program was re-

DISPOSAL BARGAINS
AT OUR BULK DISPOSAL STORE

8 PARK STREET, GLENFERRIE, VIC.
(OFF GLENFERRIE ROAD)

(Monday to Friday, 10 a.m. to 5 p.m.; Saturday 10 a.m. to 12.30 p.m.)

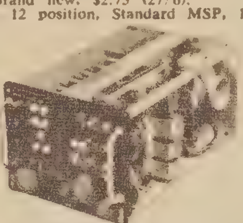
CONDENSERS

Electrolytic, Brand New, To Clear.

50MFD	200V	Pigtail	20c ea.	$2.00	per dozen
500MFD	12V	Pigtail	20c ea.	$2.00	per dozen
12MFD	50V	Pigtail	20c ea.	$2.00	per dozen
3MFD	100V	Pigtail	10c ea.	$1.00	per dozen
10MFD	12V	Pigtail	10c ea.	$1.00	per dozen

ROTARY SWITCHES

3" Diam. (MSP Type) 3 Bank, 1 Pole, 24 position. Brand new, $2.75 (27/6).
1 Pole, 12 position, Standard MSP, 10/ each.



PP/439/APG-30 (Radar) Power Supply

36 Valves, 8-6AQ5, 5-6X4, 4-12AX7, 1-OA2, 2-6AK5, 3-6AL5, 2-12AT7, 2-2D21, 1-6AS6, 4-2C51, 2-6J6, 1-6AG5, 2-6AH6, 1-6AS6. Also Twin 28 Volt Blower Motor, Relays, Variable Cond.'s, Transformers, etc. 28 volt. Ideal for wrecking. Sorry, no further information available. BRAND NEW, $35.00 (£17/10/).

STEEL TRANSFORMER BOXES

6¼" x 9" x 5" with matching lid, air vents each end. Ideal for battery charger, etc., unpainted, new, $1.00 (10/). Discount for quantity.

V.H.F. TRANSCEIVERS

TR1987 (TR1935) Supersedes SCR522. FREQ. RANGE 115-145 M/C, Crystal Locked. 21 Valves comprising 6CQ5, 6AM6, EB91, 6AM5, TT15, QVO4/7. Suitable for conversion to 144 M/C Band. (Still current for aircraft bands.) Brand new condition less crystals. $30.00 (£15). Circuits 10/ each.

SPECIALS

Panel Mounting, Cartridge Fuse Holders. 30c. $2.00 for 8.
Microphone Plugs, American Type, Ring, Tip and Sleeve, 50c.

DISPOSAL METERS 0-50 Milliamp

G.E.C. Panel Meters, 0-50 milliamp. 3¼" round. 2½" round mounting hole. Brand new, $1.75.

DURAL TUBING

¼" Tubing. 6' lengths. 36' for $2.00 or 40c per 6' length.

NEW EQUIPMENT

Available at

5a MELVILLE STREET, HAWTHORN

Telephone 86-6465

HOIKI OL-64 MULTITESTER

Specifications:
DC Volts: 0-0.3, 1, 10, 50, 250, 500, 1,000, 5,000v (20K ohms P.V.).
AC Volts: 0-10, 50, 250, 1,000v (8K ohms P.V.)
DC Current: 0-0.03, 1, 50, 500mA, 10 AMP.
CAPACITANCE. 250pF-0.02uF.
Inductance: 0-5,000 henries.
RESISTANCE: 0-5K, 500K, 5 Meg., 50 Meg-ohms.
Decibels: -20 to plus22, plus20 to plus36db (reference: 0db equals 0.775volt equals 1 mW, in 600 Ohms).
Load Current: 0-0.06, 0.6, 60 mA.
Dimensions: 5.9 x 4.17 x 1.97 inch.

PRICE (£9/17/6) $19.75

NEW MULTIMETERS IN STOCK

PT34 Pocket Mutimeter, **$5.75 (57/6)**.
200H Multimeter 20,000 o.p.v. **$11.25 (£5/12/6)**
CT330 Multimeter 20,000 o.p.v. **$15.75 (£7/17/6)**.
CT630 Mutimeter 30,000 o.p.v. **$19.25 (£9/12/6)**

RECEIVERS, Transceivers, Power Supplies, Transformers, Chokes, Output Transformers, Amplifiers, Panel Meters, Plugs and Sockets, Valves, Resistors, Condensers, Chassis, electronic racks. Over 7,000 square feet of disposals electronic equipment — stock must be cleared!

Relays, 24 volt 670 ohm. D.P.D.T. Completely sealed in case. Flying leads. Brand new, $1.50 (15/).

ERICON TACHOMETER

As above, complete. Easy to install Suction cup clips to dashboard.

12 Volt, 6 Cylinder, 6,000 r.p.m.
12 Volt, 6 Cylinder, 8,000 r.p.m.
6 Volt, 4 Cylinder, 6,000 r.p.m.
$16.50 (£8/5/) incl. tax.

PICK UP CARTRIDGES AND ARMS

Crystal Cartridge. Turnover S.T./L.P. Sapphire Stylus. Mono, $2.45. Stereo, $2.70.
Tone Arm, Plastic Stereo, Crystal Turnover, Cartridge Sapphire Stylus. Suitable Portable Record Player, $4.75.

PATCH CORDS

Standard P.M.G. type phone plug—6' lead and two alligator clips, $1.50.
DIN Single pin plug, 6' lead, shielded to 3.5mm Japanese transistor radio type plug. 95c.

ALL PRICES INCLUDE SALES TAX.

AUDIO TRANSFORMER

7000 ohm to 15 ohm. Ultra linear, 20 p.c. watt (EL34), $10 (£5).

TRANSISTOR TRANSFORMERS

OUTPUT TRANSFORMER, 300 ohm C.T. ohm. E type, $1.00.
DRIVER TRANSFORMER, 3000 ohm C.T 1330 ohm, E type, $1.00, or $1.75 pair.

TOGGLE SWITCHES

S.P.S.T.	5/ ea
D.P.D.T.	10/ '

CONDENSERS

Metal Pack, E/1 P/tail

1	uF.	350	volt	
0.25	"	350	"	
0.1	"	100	"	Price
0.1	"	500	"	all
0.05	"	350	"	1/ each
0.01	"	1000	"	or in packs
0.005	"	1000	"	of 10 for 8/6
0.002	"	1000	"	
0.001	"	1000	"	

CHOKES

7-5 H. 125mA	30/ ea
14H. 60mA	12/6 '

PLUGS AND SOCKETS

Octal Plug	3/6 ea
Octal Socket	1/6 '
5-pin Speaker Plugs	2/6 '
4-pin Speaker Plugs and Sockets	1/9 ea
6-pin Jones Plugs and Socket	7/6 ea
Pye Plugs	2/ ea
Pye double bulk Chassis Sockets	2/6 '

MODULATION AND DRIVER TRANSFORMERS

Modulation Transformer, 15 watts, pair 6AQ5 to 2E26 valve.
Also Driver Transformer, single ended prima to push-pull grids of 6AQ5s. £2 the lot, mod. Trans. 30/, and Driver Trans. 10/.

POTENTIOMETERS

Wire wound, 1½ inch diameter. Sizes available:
5 ohms, 10 ohms, 25 ohms, 50 ohms, 1 ohms, 250 ohms, 500 ohms, 1000 ohms, 20 ohms, 10K ohms, 50K ohms, 4/ each.

SPECIAL BARGAINS

P.M.G. Strip Boards, containing 24 Jacks.	30/ ea
P.M.G. Strip Boards, containing 48 Jacks.	50/ ea
Head Phone Cords, new	4/6 pa
3-pin Plug and two yds Cord	4
Mixed bags of Resistors (50)	12
P/M Fuse Holders	4/6 ea
72 ohms Co-ax Cable, 35ft lengths, 3/16 in diameter	1
72 ohm Co-ax Cable, 27yd lengths, 3/16 in diameter	2
Vibrators, 122 Type	20/ ea
122 Aerial Packs	60/ ea
12-core Cable with Plug, 22 yards long,	5
Wrecked 733D Receivers, less valves	4
P.M.G. Key Switches	7/6 ea

HAM RADIO SUPPLIERS

Phone 86-6465, 81-1935

Established 194

by Bob Padula in Melbourne on Hz when it is heard at 1100GMT. d the station on the air much earlier is frequency, and it is mixed with from as early as 0600GMT giving n impression of a 24-hour service. ydney station is normally the stronger but at 1000GMT HISD generally is onger and good program material and ication can be followed.

o Domingo is reported to use 7500W as heard more frequently before the f the Trujillo regime several years rior to which the capital was known idad Trujillo. HISD verifies reception ; and is one of a chain of Govern- operated stations which are on BC, nd FM scattered throughout the ican Republic.

RADIO GUYANA

ew country for short-wave listeners yana, the former British colony of Guiana in South America, which is sent being heard at 0945GMT on Hz. The station is using the unusual zone of 3¾ hours behind Greenwich Time, so that the station opens at MT, which is 6a.m. in Georgetown. a.

station opens with a news session and follows a musical program. Signals ir, but the station is only 5KHz from trong Voice of America program l on 5985KHz from the VOA station on, California, and it is necessary to a very selective receiver in order the sideband interference for reason- eception of Radio Guyana. We first d this station in October 1945 when ll sign was ZFY; later the station he slogan "Radio Demerara" and later adopted its present slogan, "Radio a."

SOVIET SERVICES

iet stations reported recently include Everan in the Armenian Republic, has programs in Armenian from 000 on 9800, 11705, 11790, 11830- and to North America on Saturday unday 2030-2130 on 9540, 9725, 11690 1755KHz. Radio Kiev is also heard the Ukraine in programs which are in h, and a schedule from the station the present operations as: to Europe glish 1900-1930 on 7210 and 11730- At 2230-2300, they use the MW ncy of 1241KHz. To North America ervice is 0030-0100 on 9610, 9670, 9710 and 9810KHz, and 0430-0500 on 9630, 9670 and 9690KHz. These nissions are on the air Monday, Thurs- and Saturdays, while the European e is daily. Radio Moscow's trans- n to Australia and New Zealand is nglish at 2130-2200 on 11680, 9730, 9540KHz.

OTES from readers should be sent RTHUR CUSHEN, 212 Earn Street, rcargill, N.Z. All times are Green- Mean Time, add 8 hours for Perth, hours for Sydney and 12 hours for lington time. Frequencies are now d in kilohertz (equivalent to kilo- es) in these pages.

evening services from Moscow for rs in Australia and New Zealand are e air at 1130-1200, 11690KHz; 9540, (to Sept. 1), 7280 (from Sept. 1) on 10 and 620KHz; 1230-1300 on 11690 ept. 1), 9540, 9580 (to Sept. 1), 7280 Sept. 1) and 710 and 620KHz. The transmission, 1330-1400, is on 11690, 9580, 7280, 5960, 710 and 620KHz, st two frequencies being on the broad- and. These transmitters are located in a, and this is why such excellent ion of these transmissions is achieved South Pacific. The station's Moscow ag session (in which letters from rs are answered) is on the air at on Saturday and at 1245 on Sunday.

FLASHES FROM EVERYWHERE

CAIRO is using the frequency of 17690KHz for its service to Europe, and this is on the air 2030-2105GMT with the English news at 2045GMT. The station continues to use 11915 and 9475KHz for a service in English 2130-2230, which gives better reception in the Pacific area.

UGANDA is reported to be using 4985KHz with the National Service, from the Kampala studios. This is a frequency move from 4975KHz and reception is reported in the World Publications bulletin at 2100GMT.

DAKAR which has been providing good reception on 5960KHz for some years at 0600GMT has made a frequency change for this service in French 0600-0800. The new frequency in use is 7210KHz. On this frequency it has news in French at 0700, but suffers from interference from the BBC London on the same channel.

MOZAMBIQUE's transmissions over Radio Lourenco Marques in Portuguese are tuned on 3262KHz. The station closes at 2100-GMT, while English on 3215KHz is also heard to about 2230GMT when fadeout is observed in Melbourne, according to Bob Padula.

ARGENTINA is reported to be received at good level in its English service to Europe. The station is on the air 2300-2400 using 11710KHz. The station gives the address as Argentina Radio and Television Corporation, Buenos Aires, Argentina. We also note the station using 6090KHz when they are heard at 0600 with some interference from the Sydney station VL16 using the same frequency.

NIGERIA in its English transmission in the International Service is on the air 1500-1600GMT using 11915, 9690, 7275-KHz. 1700-1900 on 15255, and from 2100-2203GMT on 11915KHz, with 9690 and 7275KHz carrying the program also. The station indicated that from 1700-1900GMT the power on 15255KHz has temporarily been reduced to 10KW. The station also has programs in French, Arabic, and Hausa. Reception reports are verified by the station.

DELHI is now reported to be on the air for Europe 1945-2230, on 7215 and 9915-KHz. To West and North Africa 1945-2045, using 9690, 11740KHz. To Australia and New Zealand the services of All India Radio in Delhi in English are broadcast 2045-2230 using 9915 and 11905KHz.

PYONGYANG Radio in North Korea continues to operate on frequences well outside the international bands and the latest schedule from the station shows a continuation of this policy. The programs in English are on the air 0400-0500, 0800-0900 on 6540 and 15520KHz. From 1100-1200, 1400-1500 on 6650 and 7580-KHz and 1900-2000 on 6540 and 7580-KHz.

SOUTH KOREA, with its transmission from Seoul, is on the air in its English programs as follows: 0300-0330 on 15135, 0500-0530 on 9640, 0630-0700 on 15125 1030-1130 and 1230-1300 on 9640KHz. Another program we hear well in English is on the air at 0830 when the frequency in use is 9640KHz.

SHKODRA in Albania confirms reception with details of its schedule. The station operates 0500-0640, 1300-1400 and 1530-2000 on 8215KHz. The Shkodra station has the address of Drejtoria e R, Shkodra, Shkodra. The station has the listed power of 200W while a medium wave station is now reported to be using 1295KHz.

ANGOLA station, Radio Angola, Luanda, using the slogan "Radio Commercial de

AUSTRIAN RADIO — SCHEDULE DETAILS

Following our report on the new Austrian Overseas transmissions in last month's issue we have received complete details on the new service from the Austrian Radio, Technical Department, P.O. Box 200 A-1045 in Vienna.

The transmissions are now on the 50KW transmitter, while a further two 100KW transmitters went into service on May 1. The station is keen to receive reports from listeners, which should be sent to Vienna. The transmitter power varies on different frequencies from 1KW, 4KW, 10KW, 20KW, 50KW, and the two 100KW which can be used on any of the frequencies on a test basis.

The present schedule from the Austrian Radio, Vienna, is as follows:

GMT	Beam Area	KHz	KW
0430-2300	Europe	6000	1
0500-0900	Europe	6115	100
0900-1100	Europe	6155	4
1700-2200	Europe	6155	100
0600-0900	Europe-Near East	7245	4
0900-1300	Europe-Near East	7245	100
1300-1500	Europe-Near East	9770	4
1500-1700	Europe-Near East	9770	100
1700-2000	Europe-Near East	7245	4
1100-1300	North Africa	11785	4
1300-1500	North Africa	11785	100
1500-1700	North Africa	11785	4
0000-0430	North America (East)	6155	10
2300-2400	North America	6155	10
0000-0200	North America	9770	100
0200-0400	North America	9770	20
2300-2400	North America	9770	100
0330-0500	Central America	15430	100
0000-0200	South America	9525	20
0200-0300	South America	9525	100
1700-1900	South America	15210	100
0700-0900	South Africa	17855	100
1500-1700	South Africa	17750	100
0600-0900	Near East	15410	20
1100-1400	Near East	11900	10
1700-1900	Near East	9610	10
0500-0700	India-Indonesia	17855	100
1300-1500	India-Indonesia	17800	100
0900-1100	Australia-New Zealand	17755	100
1100-1300	Japan	11895	100

The transmitter locations are: Aldrans 1KW; Deutsch Altenburg 10KW; Flechendorf 20KW; Kronstorf 4KW; Moosbrunn 100KW, 50KW.

Angola" is on the air 0800-1600GMT using 7295KHz and from 0500-0800 and 1600-2400 on 4795KHz.

BRAZILIAN stations at Manaus at the headwaters of the Amazon have been heard at good level. We note ZYS8 Radio Amazones using 4805KHz opening at 0900GMT. Another station in the same town, "Radio Rio Mar Manaus" ZYB 22, is reported to open at 0800, and verifies reception by airmail. The Brazilian on 15451KHz, which opens at 2100GMT, is to boost power to 2KW soon, and the station with the slogan "Radio Cl. Ribeirao Preto," ZYR206, is in Ribeirao, Preto.

BUCHAREST in Rumania is reported to be on the air in English 2030-2130, 2200-2230, 2330-2400, on 6190, 6195, 9515, 9590, 11810 and 11885KHz.

ELIZABETHVILLE is reported as broadcasting from the Congo on 11866KHz, using the new slogan "Radio Interprovincial Katanga," and is heard at 2030GMT. This station is of high power and was frequently heard during the Congo crisis.

GHANA is reported to be on the air for reception in North America when it is using English programs from its studios at Accra. The service is 0330-0430 on 6110, 2000-2100 on 11800 and 9760KHz.

INTERNATIONAL WATERS for the use of a short-wave station is news, and we have a report from World Publications which states the first off-shore station broadcasting to Britain in the short-wave band is now operating. The address of the station is "Radio Corsair," Corsair House, 86 Toronto Road, Gillingham, Kent, England. It operates on 7340-KHz, with the power of 50W. The station is located 9 miles off the north Kent coast, but is not as yet listed on a regular schedule, as it is still in the testing stages. The full schedule, which is expected to be in use by September, will have international programs. The ship uses the slogan, "This is Corsair calling on 41 for fun."

LEBANON over Radio Beirut has a service to Africa on the air from 1830-2030, which is beamed to this area on the new frequency of 15200KHz, and to South America from 2300-0100 when the transmission is on the air on 15235-KHz. The service to North America, which has programs in English at 0230-0300GMT is at present being carried on 11760KHz.

MOROCCO with the transmitters at Tangiers and studios at Rabat, is at present reported by listeners in Europe continuing to use 11735 and 15409KHz. English is 2030-2130 and French 2130-2230. The station now announces its correct frequencies, and now also uses 15333KHz for programs in Arabic which are heard 0630-1100 and again from 1200-1800-GMT. The station uses 11735KHz for its Arabic transmission also for the period 1200-1500.

CLANDESTINE station "Radio Espania Independencia" is often heard by listeners who ask us about this station and its location. It has been on the air for at least 15 years, with prog beamed to Spain and its reported tion is in Rumania. The s usually heard outside the normal wave bands. Latest reception of th nals are 1400-1515 on 14480 and 1 KHz, the latter in the 19M band. also heard 1600-2330 on 6950, 760 9975KHz, while we also hear sign 0600GMT on 10200 and 11650KHz in all cases some jamming is p on the frequencies.

CEYLON'S Commercial Service from ombo is reported by the Swiss DX sion as being heard 0600-0745 in lish on 15327KHz. The transmissi beamed to Europe, North Africa the Middle East. The station verifie ports only from its office in Bor India.

FIJI station VRH6 in Suva, which w ported to be heard opening at 1800 on 5980KHz, has made its propose quency change and is now using KHz. The station carries the E program and is also using the freq of 3230KHz with 10KW, while the channel of 5955KHz is rated as 5

BROADCAST BAND NEWS

NEW ZEALAND — A decision to ch the frequency of the new 1Z0 Tol station was made a few days befor station opened on July 9th and the stat operating on 1420KHz and not 1480K first announced. The station is on th from 1800 to 1130 daily, but sign on is GMT on Saturday. It is presumed tha change of frequency has been made to the new Whangarei repeater station (will carry NZBC programs into the N land area) to use 1480KHz. This would better coverage and would be free possible interference from the statio 1440KHz already in operation in North

INTERNATIONAL WATERS — American-operated pirate radio station now on the air off the British Coast. I Britain uses 845KHz and carries prog of middle-brow music from 050 2300GMT. Radio England which has ular music programs is on the air fo same schedule using 1320KHz.

Another new pirate station whic broadcasting to the north of Englar Radio 270 using 1117KHz. The pirate stations have come under some Govern action and the latest report is that the B Government is preparing legislation t them off the air by the end of the pr session of the British Parliament. The e iveness of any legislation in this n seems hard to follow, as most of vessels are registered in a foreign co and have only the office and the s facilities on British soil.

Nevertheless, the British Postm General, Mr Edward Short, said in P ment recently that the pirate stations be out of business early in the new He said a bill to deal with the stations around the coast of Britain, numbering ten, would be introduce Parliament shortly, and would probabl ceive the Royal assent early next year.

A British member of parliament p out in the House of Commons tha international telecommunications conve of 1959 prohibited transmissions from

Mr Short said he was hopeful tha British Government would be able to some action in the matter before Royal assent to the bill. He condemne action of the pirates, saying: "These s present a very squalid picture, — the in breach of the law, and it is n talking about lawlessness in out cities are prepared to let this take place o high seas."

Mr Short also indicated that the Go ment was looking urgently into the p lities of providing a 24-hour progra popular music to satisfy the deman this type of program.

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TECHNICAL BOOKS AND PUBLICATIONS

herent optics, holography

roduction to COHERENT OPTICS ND HOLOGRAPHY, by George W. oke. Published by Academic Press, :., New York and London, 1966. und, hard covers, 6 x 9¼in, 282 pp., ny diagrams and illustrations. Price U.S.A. $10.

scientific interest in a new published an be well gauged by the number ints requested from the author. What- ie strength of this correlation, the or papers on holography — often l to as wavefront-reconstruction raphy, three-dimensional lensless raphy, or interference pattern photo- —has been extraordinarily keen dur- e past five years. However, in all ears one never caught up with the some new improvement was always ; in the Press.

pears that the demand for the pub- works of George W. Stroke and his kers grew beyond reprints limit and ere remained a permanent interest nis Gabor's original papers on holo- published in 1948-51, and in E. . Upatneik's papers published in 4. It is estimated that at least 50,000 se papers in the form of photocopies eprints are distributed all over the

irst comprehensive presentation of aphy was contained in Professor W. Stroke's 138-page lecture notes l "An Introduction to Optics of nt and Non-Coherent Electro- tic Radiations," first compiled in is a University of Michigan publica- The exceptionally heavy demand for notes urged the author to publish a elf-contained book on holography: ntroduction to Coherent Optics and raphy," by Academic Press, in Febru- is year. The first stock of this book uickly sold out in the U.S.A., but supply has been continuous.

book is based on the author's lecture and contains much original scientific the electro-magnetic theory: however, the material. The reader is assumed to be familiar with the mathematical treatment of text is so clearly presented that an intelligent layman can understand many of the basic ideas by means of excellent diagrams and photos alone.

The seven chapters deal, sequentially, with general principles of physical optics and electromagnetic theory, diffraction theory, image formation and coherence, followed by the discussion of theoretical and experimental foundation of holography. In this chapter, the author's many original scientific innovations are incorporated. For the experimental holographer it offers invaluable guidance in a field where success is difficult to obtain without previous experience in interferometry and diffraction.

The last chapter explains several special mathematical topics used in theoretical holography, such as Fourier transforms, convolutions, correlations, spectral analysis, and the theory of distributions. This chapter is meant to enable undergraduate students with a limited mathematical background to follow the text more easily.

Finally, the inclusion of Professor D. Gabor's three "classical" papers on holography is most helpful to an uninitiated reader. The first of these entitled "A New Microscopic Principle" serves as a non-mathematical and historical introduction to holography and should, perhaps, be read first. This reprint also establishes an historical link between holography and the Research Laboratory of the British Thomson-Houston Co., where D. Gabor obtained first practical results, as vividly recalled by Professor C. J. Milner, of the University of New South Wales, then a colleague of Professor Gabor, at Rugby, England.

The book is amply illustrated with photos and many almost self-explanatory diagrams. It also contains a complete list of references and both author and subject indices.

Review copy direct from Academic Press, Inc., New York. (E. Laisk.)

NIQUES OF COMPUTER MAN- GEMENT, published in five volumes y International Computers and Tabu- tors, London. Obtainable from Tech- ical Publications, I.C.T. House, utney, London, S.W.5. U.K. price :10/10/.

iew copies of these volumes have not ubmitted, but I.C.T. has provided the ing information.

echniques of Computer Management' set of five volumes including one e specially prepared for senior man- nt. Other sections are intended for rocessing managers, systems analysts, programmers. These volumes are a tion of I.C.T.'s experience, gained the years, of the installation of com- and the development of efficient ter systems for a wide variety of sations. By using these volumes, man- nt can be confident of installing a ter and developing the systems in quired time schedule and within the t.

ese techniques are practical. The es outline a method of planning and l, using a network system covering such points as site preparation, staff requirements, training and utilisation, changeover procedures, company education, and so on. Standard procedures and documentation are also provided for systems analysis, the writing of programs and the organisation of the data processing centre."

Intending purchasers should note that I.C.T. has an Australian company, International Computers and Tabulators Australia Pty. Ltd., 102-106 Arthur Street, North Sydney, who will no doubt be able to provide further information and assist in arranging importation from U.K. (H.A.T.)

N.Z.A.R.T. CALLBOOK. Published annually by the New Zealand Association of Radio Transmitters (Inc.), Box 1733, Christchurch, N.Z. Paper covers, 9½ x 7¼in, 68pp. Price in New Zealand 7/6.

This annual publication contains a considerable amount of useful information for amateurs in the Pacific area. In addition to up-to-date listings of all New Zealand amateurs, it contains details of N.Z.A.R.T. awards and contests and general information.

Copies are obtainable from the address given above, and intending purchasers should note that the price quoted is in New Zealand currency, and that when converting to Australian decimal currency sufficient should be allowed for postage. (H.A.T.)

MULLARD BULLETIN, Vol. 3, No. 3 (February, 1966) has descriptions of the following Mullard products: Low noise microwave tunnel diodes designed for use at frequencies up to 4GHz; ZC1030 "smaller than subminiature" cold cathode trigger tube; eight new quick heating valves for mobile and fixed transmitters up to 500MHz; Ticonal G and GX high energy permanent magnet material; J band magnetron for medium range navigational radar; Ferroxcube toroids with nylon coating; ZM1024 cold cathode neon indicating tubes for character display; Propathene moulded self-locking adjusters for Vinkor adjustable pot-core assemblies; VPP-7 ultra-high vacuum pump.

New transistor types described are: high gain silicon planar epitaxial transistors (a) BC107 "TVistor" (b) BC108 high performance transistor (c) BC109 high quality

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**ILIPS SCIENTIFIC AND INDUS-
L EQUIPMENT BULLETIN,** Volume
). 10 (July, 1966) has the following
s: The Glass Electrode and its Appli-
to pH Measurement; Philips Cryo-
ators; Tilting the Specimen in the
00 (electron microscope); Extra lines in
Spectroscopy; "Neutrocoax" from
s-Sodern, a neutron monitoring ver-
f the "Thermocoax" cable; The Philips
curie Meter; Scientific and Industrial
ment News. (Philips Electrical Pty.
Scientific and Industrial Equipment
ion, 69-79 Clarence Street, Sydney.)

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Inquiries should be sent in the first instance to the Australian agents, who are Wm. J. McLellan and Co. Pty. Ltd., The Crescent, Kingsgrove, N.S.W.

MULLARD—AUSTRALIA PTY. LTD. has available reprints of an article describing their "Mini Speaker" design for small loudspeaker housings, originally published in "Mullard Outlook." This leaflet contains all the constructional details, with a diagram showing dimensions of the component parts. Mullard request that those wishing to obtain this leaflet should send a stamped, self-addressed envelope, endorsed "Mini Speakers," to the company head office at 35-43 Clarence Street, Sydney.

MULLARD OUTLOOK, Vol. 9, No. 3 (May - June, 1966) contains a further article about the company's new design for small loudspeaker enclosures; a description of a three watt transistorised stereo power amplifier with tone controls; A discussion about the properties of ceramic piezoelectric material "Piezoxide"; details of the full range of Mullard ferroxcube toroids; and news items. (Mullard - Australia Pty. Ltd., 35-43 35-43 Clarence Street, Sydney.

TECHNICALITIES (August, 1966), the new products bulletin of Tecnico Electronics Pty. Ltd., has items about printed circuit plating; Pye "Smoothspeed" regulators, "Slidup" variable transformers and Pye joystick controls; Bach - Simpson volt - ohm milliammeters, plug-in units and transistor tester; Shaw moisture meters and recording alarm hygrometer; Dytronics Inc. tunable spectrum analyser; Princeton Applied Research lock-in amplifier and digital voltmeter; F. W. Bell Inc. gaussmeters, multipliers and transducers; Microtest Ltd. power meter and temperature compensated power meter; Thomas Industrial Automation Ltd. universal bridge; Del Electronic Corp. Hi-Pot testers; Corona Electric Ltd. oscilloscope plug-in unit; Finnish Cable Works Ltd. contact defect test set; Herga Electric Ltd. foot switches. (Tecnico Electronics Pty. Ltd., Carrington Road, Marrickville, N.S.W.)

TECHNICAL NEWS BULLETIN, Vol. 50, No. 5 (May, 1966), published in U.S.A. by the National Bureau of Standards, has the following articles: Standard reference material for Mossbauer spectroscopy; Tenth scintillation and semiconductor counter symposium: Minimum venting for plumbing systems. National Standards transferred on N.B.S. 65th birthday; Electromotive series for solid and molten oxides and halides; Semiconductor flaw study initiated; Decomposition of multiply - charged ions; New thermocouple tables; Information on Standards and news items. (Inquiries to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402.) ■

RRATA, NOTES —

**HOMETER, DWELL METER, Oc-
er, 1964:** In certain conditions of
eration, as when voltage is present
ween the engine points, with the
gine stationary, it is possible to
erload the meter when switching
m the "5000rpm" position to the
well" position. This is due to switch
ntact S2a failing to remove quickly
ough the short across the multiplier
work 15K plus 10K pot, and before
completes the circuit to position
To eliminate this risk, it is sug-
ted that S2a and S2b should be
n-shorting type contacts. However,
shorting type is best retained for
in order to ensure that there is
hunt across the meter at all times.

1966 3-INCH OSCILLOSCOPE, May, 1966: A number of intending constructors have reported difficulty in obtaining the 6GH8A valves employed in the vertical amplifier. We understand that the shortage of these valves is only a temporary situation but intending constructors may be interested to learn that the type 6EA8 valve may be used in this circuit as a plug-in replacement. The 6BL8 may also be used in this fashion, although the latter are not really recommended, as performance will not be as good as with the 6GH8A or 6EA8.

LIE DETECTOR, Reader Built It, June, 1966: Meter shunt shown as 7.5K should read 7.5 ohms.

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over is at 4 kc/s. See reviews in the "Gramophone," p. 511, Ap
'65 and "Hi-Fi News," p. 75, June, '65.

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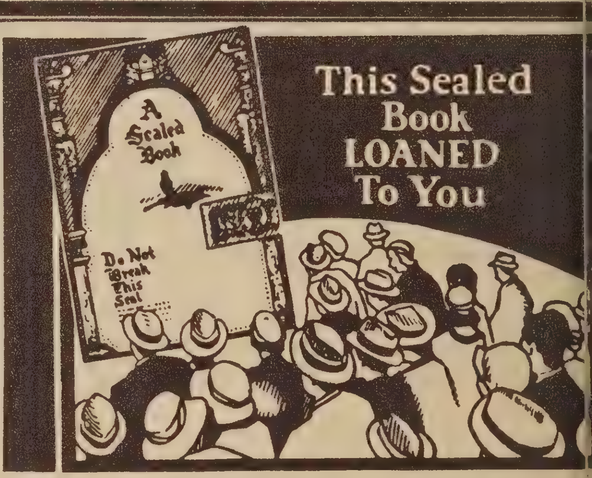
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NSWERS TO CORRESPONDENTS

rom time to time, New Zealand
aders inquire as to the best
ethod of sending money to
LECTRONICS Australia for
e purchase of circuits, blue-
ints, back copies, etc.
'e have been advised that there
no restriction on the purchase
f such items, provided the out-
y does not exceed £2 and that
e money is remitted to Aus-
alia by either N.Z. or English
Money Order. Upon application
any post-office in New Zea-
nd a money order for up to
/ per person per day will be
sued. For amounts over 5/,
e requisite number of applica-
ons must be made to separate
ost-offices or on separate days.
is illegal to remit New Zea-
nd banknotes overseas.

BEWILDERED READER

ort Macquarie, N.S.W.) writes ask-
our opinion for various combina-
s of audio equipment including
mercial and Playmaster equipment.
he asks whether there are any
able transistorised tuners for use
transistorised audio amplifiers.
nately R.K. we cannot discuss the
r shortcomings of commercial audio
nt in combinations such as listed
letter, or compare it with our own
nt. Not only would it be necessary
extensive files listing characteristics
commercial equipment but the time
precludes the use of our technical
this purpose. We can only com-
at the combination of our own pro-
hich you suggest, should perform
ly well, and we think you would
satisfied with it. However, the ele-
speaker mounting suggested could
pare with our Bookshelf design.
do not know of any commercial
rised tuner which would give a
ble reproduction for high quality
. However, we have such a tuner
list of projects and will eventually
nd to publishing a suitable circuit.

COMPLEX AUDIO MIXER

Nth. Williamstown, Vic.) is another
der who would like to see described
omplex audio mixer, referred to in
June issue, on this page.
you for your letter, which has been
We have noted also your request for
voltage neon light system suitable
avans, etc.

AMPLIFIER DESIGN

(Christchurch, N.Z.) expresses his
asure at the successful construction
the 110 Stereo Tape Amplifier. He
ntions a project he is tackling and
quests help with the design. Also
ormation on obtaining past articles
required.
e pleased to hear of your success
he tape amplifier but regret that
not enter into correspondence re-
designs other than those featured
cles in the magazine. We often
requests of this nature and regret
is necessary to refuse, owing to the
of time which this would involve.
ints of the two articles mentioned
letter are available through the
tion service for 20c each. These
include all information given in
ginal publication.

ELECTRIC MOTORS

A.G.B. (Paddington, N.S.W.) writes relating his experience with instrument motors and asking for information on small capacitor start motors.

Unfortunately we have not published any information on this type of equipment in the magazine and cannot therefore assist with your enquiry. In circumstances like these it is often helpful to pay a personal visit to some of the leading technical book-stores and browse through the available literature. Usually there is some publication which will give the required information

RADIO COURSE

J. A. (Ovingham, S.A.) says that he is connected with the Youth Radio Scheme and feels that there is a need for something like our Basic Radio Course in book form.

We have had a lot of requests along these lines and are currently in the process of working out practicability and costs. In the meantime, we are simply not able to supply back numbers or reprints containing the Course, as originally published.

RECORD REVIEWS

D. E. (Queenstown, Tas.) is a keen follower of our Record Review pages, which he rates as about the best in Australia. Our reviewers, he says, appear to be interested in different types of music and do not use the space merely to propagate their own particular tastes.

Thank you for the nice compliment. A reviewer must hold and express opinions but our reviewers try to maintain a balance between what they like personally and what they realise that others may like. Regarding equipment, it is not unusual to see in advertisements claims which are strictly incorrect. It is inconsistent therefore to quote a wow and flutter figure of .02 per cent and then state that a turntable is free from wow and flutter. What is really meant, we suppose, is that the wow and flutter has been reduced to the small figure quoted and that, as far as the listener is concerned, it has been reduced to an inaudible level. The same kind of remark could be applied to speed regulation, whether dependent on the mains frequency or on a governor system. As regards certain equipment being independent of mains voltage and frequency, it is best to be guided by a detailed reading of the specifications. The "Communications Eight" must unfortunately be regarded now as out of date, despite the fact that it was described not so long ago. The circuitry is quite in order but the Geloso Company in Italy suddenly suspended manufacture of the prealigned front-end and it was only a special effort on the part of the local agents that allowed them to keep faith with those who had become involved in the design. We have had no news about any replacement front-end.

RATEMETER

L. P. S. (Brisbane, Qld.) asks if we could publish an article dealing with the use of a "ratemeter." He also inquires regarding the colour-coding of small capacitors, and the significance of "Hi-K" as used to describe a certain type of ceramic capacitor. He would like to know the uses of such capacitors.

To our knowledge, L.P.S., a ratemeter is virtually the same as a frequency meter of the type that staff member Ian Pogson described in the recent June issue. Thus we would refer you to this article for the uses of such an instrument. The colour-coding of small capacitors is not entirely standardised, some manufacturers employing a coding system that corresponds roughly to the resistor colour code (reading in pF rather than ohms) but others employing a code of their own. Perhaps the best course when in doubt is either to measure the unit on an RC bridge, or to inquire from the manufacturer. "Hi-K" ceramic capacitors are those that make use of a special ceramic material with an extremely high dielectric constant (K) in order to provide a high capacitance in a small space. However, as this material is somewhat temperature dependent and hard to control precisely during manufacture, Hi-K capacitors are in general not suitable where value, stability and accuracy are required. Their main use is as bypass capacitors, a role that they fill admirably.

"ELECTRONICS Australia" INFORMATION SERVICE

TO assist readers, "ELECTRONICS Australia" conducts a technical information service. Conditions governing this service are set out below:—

(1) Address letters to: Assistant Editor, "ELECTRONICS Australia," Box 2728, G.P.O., Sydney.

(2) Requests for copies of circuits or technical information requiring a postal reply must be accompanied by postal note or stamps to the value of $0-20 (2/-). Queries not accompanied by a fee will be answered in rotation on these pages.

(3) For the $0-20 fee, we will supply circuit data, as available, from our files. The amount of data available varies, but in no case can it include information additional to that already published in the magazine. For complicated projects involving material extracted from more than one issue, an extra fee may be requested. As a rule, requests for circuits will be answered more speedily if they are not complicated by questions requiring the attention of technical personnel. Where articles are not on file we can usually provide a photostat copy at $0-20 PER PAGE.

(4) The information service is aimed primarily at assisting readers in matters relating directly to articles published in the magazine. Answers will be given in note form and only so far as can be drawn from general knowledge of the relevant subject. We cannot provide lengthy answers, undertake special research, discuss commercial designs or draw special circuits. Please note that the inclusion of an extra fee does NOT entitle correspondents to special considerations.

(5) The editor reserves the right to return fees or to limit the scope of an individual reply when it is felt that a partial answer will be better than none at all.

(6) In addition to the above service, chassis blueprints are available for most of our projects showing the position of holes and cutouts for metal-working, but containing no details of wiring. Apart from complicated projects like TV sets and oscilloscopes, most blueprints cost $0-50 (5/-) each. Original photographs of most projects are also available, from $0-50 for a 6in x 8in glossy print, postage $0-08 (9d).

(7) "ELECTRONICS Australia" does not deal in radio components nor will we debate the relative merits of competitive products. Prices and specifications should be obtained from advertisers.

(8) Technical queries are not answered by telephone.

(9) We have no file of circuits for commercial radio or TV sets, etc.

(10) A fairly good range of back numbers is available. On issues up to 6 months old there is a surcharge of 5c (6d). On issues from 7 to 12 months old the surcharge is 10c (1/-). Over 12 months, it is 20c (2/-).

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PETER G. BROUGHTON

211 George Street
Sydney Tel. 27-5831

PWM amplifiers — The case for the X-

(Continued from Page 111)

"14. Mr Rowe mentions that heterodynes were observed when frequencies above 7-8KHz were fed into the amplifier. These may have been the result of faulty connections, but it is also possible that he was feeding in high frequencies at a high amplitude, which caused clipping. This would certainly produce heterodynes, but no audio amplifier is ever required to amplify large amplitude frequencies above about 5KHz as only the harmonics of musical instruments or the human voice occur at these frequencies. The X-20 simply does not produce audible heterodynes with music or speech even at full output.

"I regret that I have had to be so critical of Mr Rowe's article in this letter, but I feel that the technical inaccuracies it contained and the unfair testing of our amplifier make this necessary.

"Pulse width amplifiers are difficult to design, mainly beca is not the large amount of experience available that give starting point, but when desig fully they work extremely offer exciting advantages over tional types. My own compan factures transistor amplifiers put powers as high as 200 highly specified industrial app so we have some experience of ject and we are confident th amplifiers have a very bright futu of them.

"Yours faithfully,

"SINCLAIR RADIONI
(C. M. Sinclair, Managing D

Mr Rowe: With the units set we have conducted further tests gating the heterodyne effect. Th seems to be that if one feeds a at the volume control, bypas preamp stage, heterodynes a audible even at output powe around 0.5 watts RMS and w siderable precautions taken wit ing of the input leads, etc. Bu feeds signals in through the pre heterodynes do not become evid rather higher output (and di levels are reached.

I must admit that searching the X-20 booklet reveals that it suggests that one may feed si directly at the volume control. by the same token, it nowhere that this cannot be done. In amplifiers it is fairly common to bypass preamps, as these ca give a misleading picture of the ities of the basic power amplifi

We followed this course w X-20 for two reasons, one posi one negative. The negative rea that an inspection of the circuit that the preamp was a stage ventional design whose perf seemed irrelevant to the discu PWM. The positive reason was signal-to-noise ratio of the prea rather poor and under the circu we thought it kinder to ignore

Although PWM amplifiers m have a bright future ahead of the industrial power amplificati I frankly doubt whether they similar future in high-fidelity au course I may be wrong; if I am, Mr Sinclair won't hesitate to an article describing PWM's su together with an "I told you s to yours truly!

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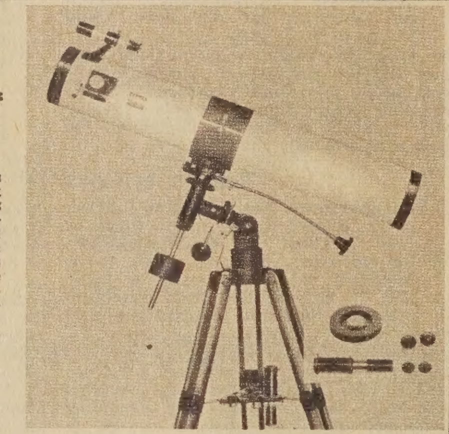

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